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USDA REPORT ON WATER AND RELATED LAND RESOURCES

GOOSE LAKE DRAINAGE BASIN

OREGON

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1978

USDA-SCS-PORTLAND, OR. 1979

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OREGON

ADDENDUM

OCTOBER 1979

The Conclusions section of the report SUMMARY on page ii is revised to read as follows:

CONCLUSIONS

The study provides an inventory of the Basin's resources and the related problems and needs. Some of the resource problems identified may be solvable through the provisions and authorities of Public Law 566.

A planning study is being conducted on the Thomas-Cottonwood Creek Watershed. Preliminary indications are that a water storage project does not appear economically feasible when evaluated in accordance with current guidelines and under present economic conditions.

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1978

USDA SCS-PORTLAND, OR. 1979

CONTENTS

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TABLES

FIGURES

MAPS

SUMMARY

SUMMARY

NEED FOR STUDY

The State of Oregon, through the Water Resources Department, has requested the U.S. Department of Agriculture to cooperate on a Cooperative River Basin Study in the Goose Lake Drianage Basin.

The State has determined that the Goose Lake Drainage Basin is a high priority study area in Oregon due to severe problems affecting the economic and natural resources of the Basin. Water shortages, inefficient off-farm and on-farm water-delivery systems, inadequate drainage, flooding, and severe erosion and low range forest productivity adversely affect agricultural output. Conflicting private and public uses impact the economic development and environmental quality of timber resources and related sectors of the economy.

Section 6, PL 566 as amended, authorizes the U.S. Department of Agriculture to cooperate with States in Cooperative River Basin Studies.

GENERAL DESCRIPTION

The Goose Lake Drainage Basin is located in Lake County, Oregon and Modoc County, California. The area of concern for this study is that portion that lies within the State of Oregon. The study area has a drainage area of 464,270 acres. Goose Lake is supplied by three headwater streams and many small streams; the major streams are Thomas Creek, Cottonwood Creek and Drews Creek. Major land uses in the Basin are forestland, 211,180 acres; range and pasture 166,550 acres; cropland, 44,390 acres; and other lands, 42,150 acres.

PROBLEMS AND OBJECTIVES

The principal problems in the Goose Lake Drainage Basin discussed in this report are: winter and spring flooding, erosion and sedimentation, impaired drainage, water shortages, water use and conservation and water quality. These problems are extremely important to consider in connection with improved management opportunities for agriculture, range, and forestry.

The overall objective of USDA participation in this study is to inventory the resource problems and needs of the Basin and identify potential watershed projects. Another objective of the study is to provide relevant inventory data to Lake County for use in the planning process and the State Water Resources Department for use in the State Water Resources Program.

Available data will be developed and compiled to make it suitable for use by local decision makers and by State, USDA, and other Federal

agencies in making decisions and initiating action programs for water and land resource conservation, utilization, management, and development.

Thomas Creek, near Lakeview, has been identified as an early-action watershed.

Specific objectives as listed below were developed by the cooperating state agency:

1. Determine water and related land resource management problems and needs.

2. Determine irrigation and drainage problems and needs.

3. Identify flood, erosion, and sediment problems and damages, and the opportunities for damage reduction.

4. Evaluate the fish and wildlife opportunities.

CONCLUSIONS

The studies have determined that the problems as outlined in the sponsors application for assistance can be solved through the provisions and authorities of Public Law 566. Studies indicate that a project meeting the sponsors' objectives can be developed for the Thomas-Cottonwood Creek Watershed.

INTRODUCTION

INTRODUCTION

The water and related land resources of the Goose Lake Drainage Basin are described and evaluated in this report. The overall objective of USDA participation in this study was to summarize existing data on the water and related land resources, the resource problems and needs and to identify potential watershed projects. Another objective of the study was to provide relevant inventory data to Lake County for use in the planning process and the State Water Resources Department for use in the State Water Resource Program.

The Goose Lake Drainage Basin is located in Lake County, Oregon and Modoc County, California. The area of concern for this study is that portion that lies within the State of Oregon. The study area has a drainage area of approximately 725 square miles or 464,270 acres. Goose Lake is supplied by three headwater streams and many small streams; the major streams are Thomas Creek, Cottonwood Creek and Drews Creek. Land uses in the Basin are forestland 211,180 acres; rangeland 118,280 acres; cropland 44,390 acres; improved pasture 48,270 acres and other lands 42,150 acres. In general, the climate is temperate with amounts of precipitation variable over different parts of the Basin, low winter temperatures, moderately high summer temperatures, and short frost free growing seasons. The two most important economic activities are the lumber and agricultural industries.

This study was conducted by the USDA Oregon River Basin Staff as a result of a cooperative agreement between the U.S. Department of Agriculture and the State of Oregon. According to the agreement, the USDA Oregon River Basin Staff supplied a summary of existing data pertaining to agriculture and forestry and problems and needs (especially involving water). Economic description, utilization and management of resources, and potential project activities were provided to the State Water Resources Department. In return, the State Water Resources Department furnished information on the basic hydrologic characteristics, present and future demands and needs for water, existing appropriation of water and water rights, and reports of hearings. The U.S. Department of Agriculture authorized the survey under the provisions of section 6 of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, as amended). The USDA Oregon River Basin Staff is composed of personnel from three agencies--Soil Conservation Service (SCS), Forest Service (FS), and Economics, Statistics, and Cooperatives Service (ESCS).

The cooperative river basin survey primarily consisted of accumulating, evaluating, and interpreting existing data, both published and unpublished, much of it furnished by cooperating groups

and agencies. In addition, reconnaissance studies by the Staff to gather basic data included: (1) investigating possible reservoir sites to verify physical characteristics; (2) accumulating an inventory of the present vegetative cover, land utilization, and land ownership and potential availability of the resources for future development; and (3) determining problems and needs within tributary watersheds. Much of the information for this broad survey was obtained by consulting and interviewing local, private, and public officials who possess first-hand knowledge. The basic, supporting data used to develop the statistical information in this report are stored in the files of the USDA Oregon River Basin Staff.

Valuable assistance in this survey was provided by several agencies and organizations. The SCS technicians, headquartered in the Basin, furnished much of the basic information concerning tributary watersheds. Most of the land ownership information was obtained from the records of the Lake County Assessor. Much information of forest and range and pasture lands was furnished by the field offices of Forest Service, Pacific Northwest Forest and Range Experiment Station, Bureau of Land Management, Fish and Wildlife Service, and Oregon State Forester. Certain agricultural data was obtained from publications of the Bureau of Census, ESCS, and the Science and Education Administration. Several of these agencies also supplied helpful consultation and comments in the preparation of the report.

NATURAL RESOURCES OF THE BASIN

NATURAL RESOURCES OF THE BASIN

LOCATION

The Goose Lake Drainage Basin is located in south-central Oregon, and comprises all lands draining into Goose Lake. The study area contains 464,270 acres.

Goose Lake, at the southern end of the Basin is a body of shallow water averaging about 20 feet in depth and 170 square miles in surface area. Although physically a part of the Pit River drainage, Goose Lake has not discharged during the past 95 years. A broad valley extends from the lake to the north and northwest, the gentle slopes giving way to rugged mountains which reach elevations of 8,000 feet. Along the easterly side of the lake, the Warner Mountains rise abruptly, a narrow bench intervening, to an elevation of over 8,000 feet.

The drainage system of the Basin is made up of a large number of independent streams with those flowing into Goose Lake from the north and east generally perennial. Streams originiating at relatively low elevations, which includes those flowing from the west, are intermittent.

Drews, Cottonwood, and Thomas Creeks, the three largest streams in the system, drain 352,000 acres, more than one-half of the Basin. Other significant streams in the Basin are Crane, Cogswell, and Kelly Creeks, originating in the Warner Mountains and Dry Creek, flowing from the west.

This study is limited to that portion of the Goose Lake Drainage Basin within the state of Oregon.

Drainage basins contiguous with the study area include the Klamath Drainage Basin on the west, Warner Lake Basin on the east, and the Chewacan Drainage Basin to the north. The study area is largely in Lake County, but includes a small area of Klamath County (Table 1).

LOCATION MAP

GOOSE LAKE DRAINAGE BASIN

OREGON

1978

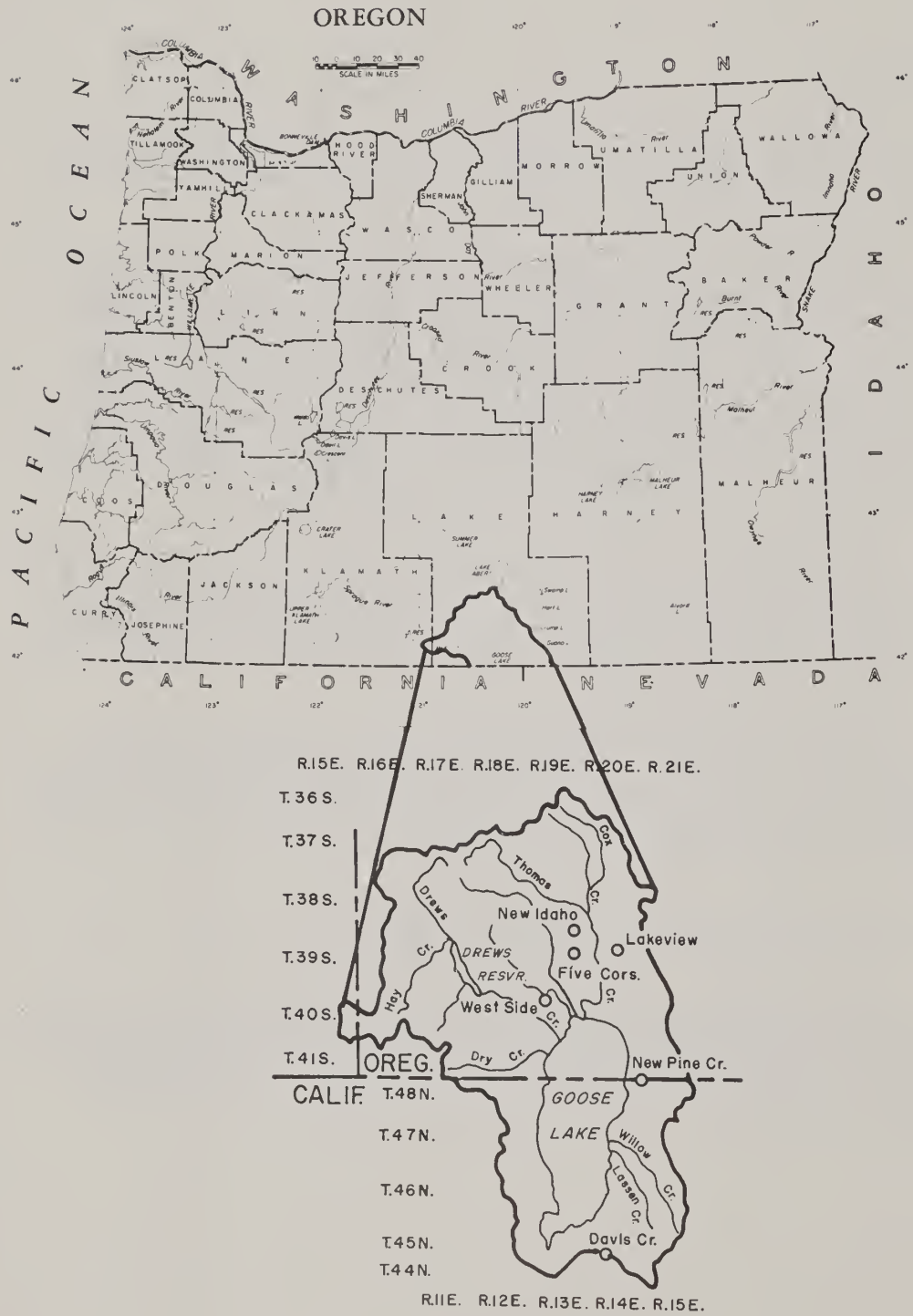


Table 1.--Basin Area by County, Goose Lake Drainage Basin, Oregon 1976

County	County Square miles	Basin Square miles	Acres	Percent of county	Percent of county
Lake	8,340	719	460,570	8.6	99.2
Klamath.	6,151	6	3,700	0.1	0.8
Total		725	464,270		100.0

Source: USDA River Basins Staff

CLIMATE

The climate of Goose Lake Drainage Basin is semiarid with relatively warm summers and somewhat severe winters. The mean annual temperature for Lakeview was 46° during the period 1931-1960. The variation was from 67°F. for July, which is the warmest month, to 27°F. for January which is the coldest month. Monthly variations are shown on Figure 1. Extremes of 108°F. and -24°F. have been recorded.

Precipitation varies from about 10 inches on Salt Creek to about 25 inches on Quartz Mountain (Precipitation Runoff Map). An analysis of USDA Cooperative Snow Survey data and existing maps indicate 71 percent of the Goose Lake Basin mean annual precipitation falls in the form of snow. Lakeview with a mean annual precipitation of over 14 inches has a mean snowfall of 52 inches. Heavy snowfall often has a positive effect on the availability of natural flows for irrigation water but sometimes a detrimental effect on spring flooding.

The Rainfall Frequency-Duration (Figure 2) indicates rainfall intensity in inches for storm duration periods of 2 to 24 hours by return frequencies of 2 to 100 years. Mountain air temperatures are cooler and generally decrease 3°F. with each 1,000-foot increase in elevation. On the other hand, precipitation tends to increase with increase in elevation as demonstrated on the precipitation-elevation Figure 3.

The basin is often subjected to summer convection conditions resulting in showers which provide much of the June-September precipitation. Many of these local storms turn into "cloudbursts." High-intensity storms result in a rapid runoff causing severe soil erosion and flood damage while adding very little to soil moisture.

FIGURE 1

Mean Air Temperature for Lakeview, Oregon at 4,756-Foot Elevation

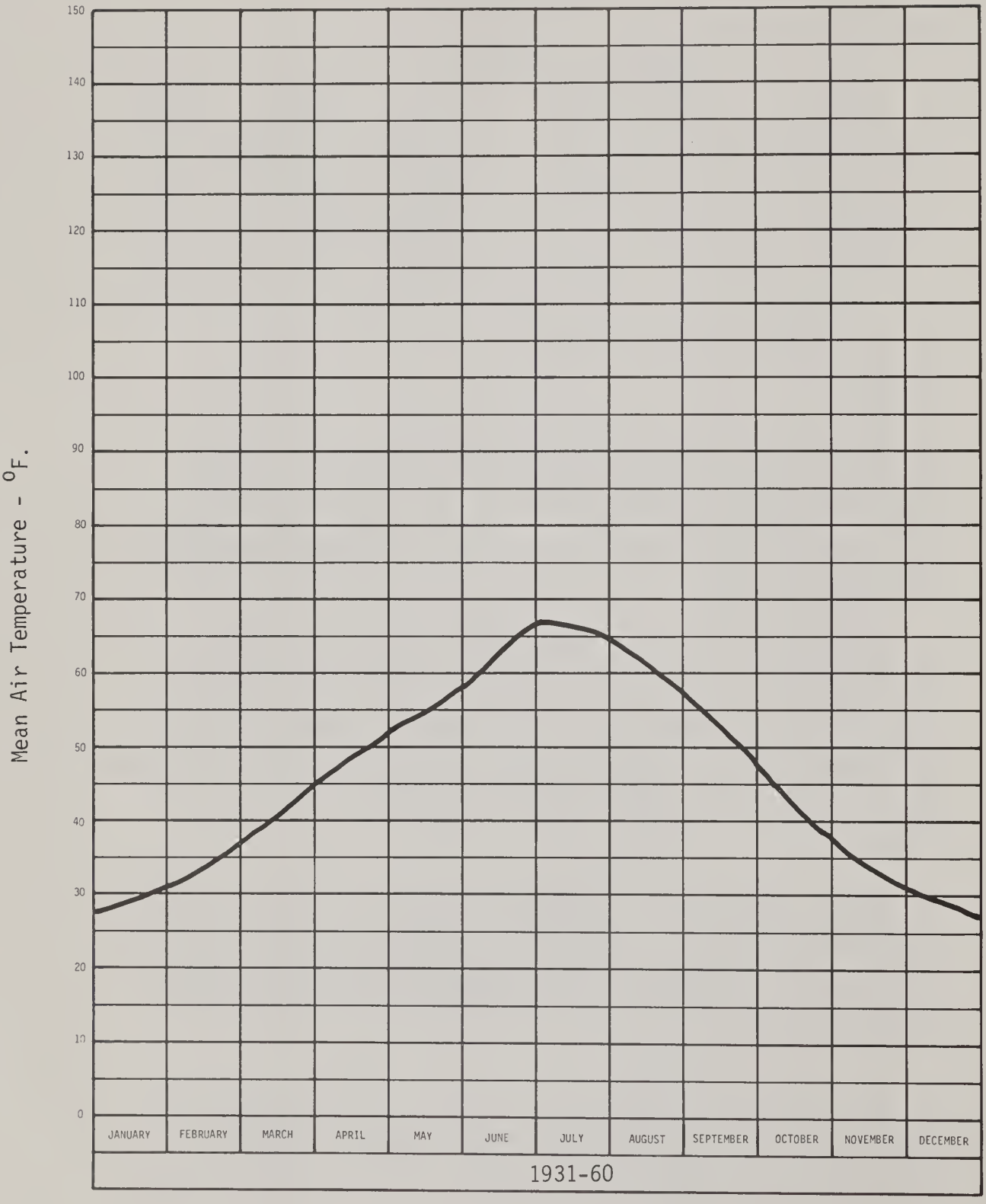
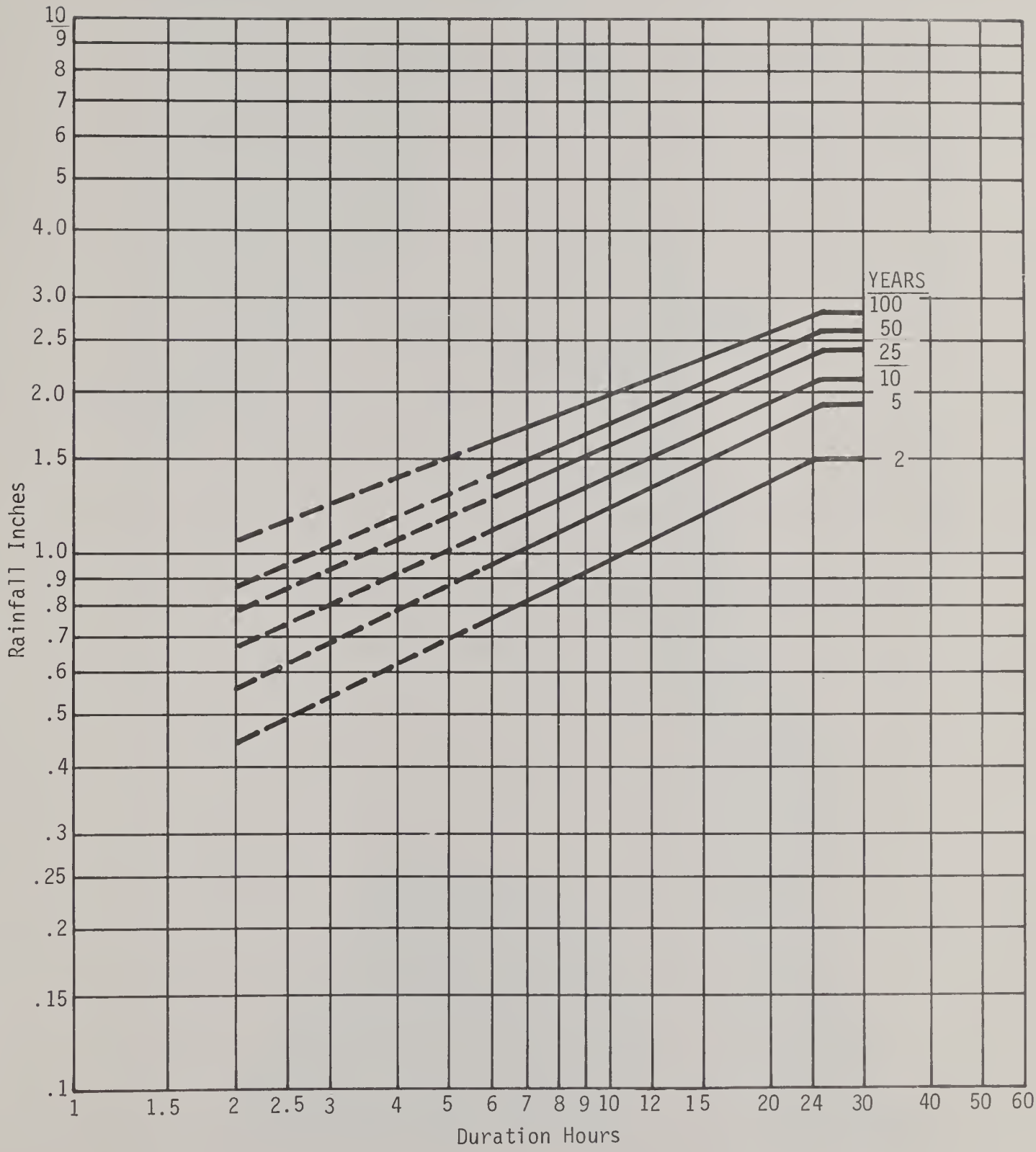


FIGURE 2

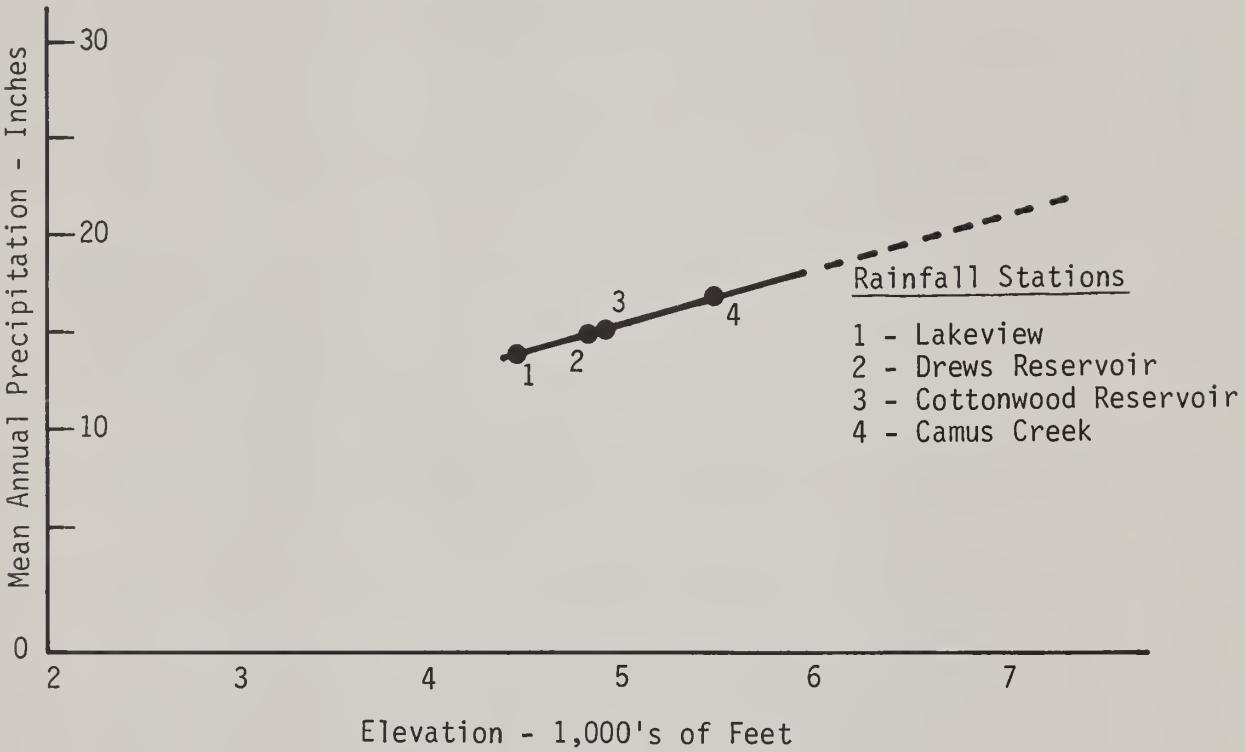
GOOSE LAKE BASIN
Rainfall Frequency - Duration

Duration: 2 Hours to 24 Hours
Frequency: 2, 5, 10, 25, 50, 100 Years



Source: NOAA Atlas Z
Volume X - Oreg

FIGURE 3 --Precipitation and Elevation Relationships



PRECIPITATION - RUNOFF

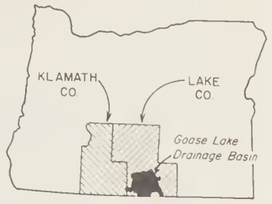
GOOSE LAKE DRAINAGE BASIN

OREGON

JULY 1977

1 0 1 2 3 MILES

SCALE 1:208,000



LOCATION MAP

LEGEND

- Basin Boundary
- Forested Lands Boundary
- Lakes over 40 acres
- Contour Lines
- Precipitation in Inches
- Runoff in Inches
- 4 — Elevation 4750'
- 15.5/8 — Elevation 5000'
- 17.5/15 — Elevation 5500'
- 18.5/43 — Elevation 6000'
- 19.5/49 — Elevation 6500'
- 2/58 — Elevation 7000'
- 12.5/68 — Elevation 7500'

Source:
Base map prepared by SCS, WTSC Cartographic Unit from USGS 1:24,000 quads.
Thematic detail prepared by USFS S&PF. Developed from precipitation-elevation and precipitation-runoff regression curves developed by C. Benoit Hydrologist USFS.

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M7-SN-23835-5

Goose Lake Basin has a short growing season ranging from 120 days in the open lower valleys to 80 days in the higher elevations. Freezing temperatures have been recorded every month of the year.

TOPOGRAPHY

Basin Areas

The study area is in the Basin and Range Province and consists of a series of mountain ranges and ridges generally oriented in a north-south direction and separated by oblong to long narrow valleys mostly lacking drainage outlets or having only partial outlets. The lower parts of these valleys, with a few exceptions, are somewhat poorly to very poorly drained and have accumulated alkali salts. The topography of the area has been produced by faulting, or differential earth movement, in which one edge of the earth has been thrust up with the corresponding opposite side thrust down along a more or less straight line or axis. Elevation of the basin floors generally ranges from around 4300 to 5500 feet. The higher ridges and mountain peaks vary from around 6000 to slightly over 8000 feet.

Lakes, at different times during the Pleistocene epoch, filled most of these valleys to depths of several hundred feet, forming terraces and deltas on which much of the irrigated and dryland farming is presently done. The northern and western parts of Goose Lake Valley consist mainly of old high lake terraces and delta deposits, many now disected and eroded to rolling and hilly remnants of their original forms. The Drews, Bieber and Salisbury soils occur primarily on these terraces in Goose Lake Valley.

Some of the valleys have alluvial bottomlands and floodplains centrally located, such as Goose Lake Valley. Lakeview, Goose Lake and Ozamis soils are moderately well to poorly drained, nonsodic soils on bottomlands and floodplains of the Goose Lake valleys. The Stearns and Scherrard series are sodic, or alkali, soils having wetness problems on these bottomlands.

Ridge Slopes

Areas of steeply sloping land comprise a rather large proportion of the total land area of the Basin. Almost all of this land consists of ridges and escarpments of fault-formed origin, varying in elevation from a few hundred to more than 2000 feet above the basin floors. The upthrust sides of the ridges are much steeper in most cases than the downthrust sides. The ridges are narrow shaped and range from less than a mile to more than 20 miles in length.

The Warner Mountains and timbered and range areas west and north of Goose Lake Valley consist generally of moderately steep to steep ridge slopes on which the Woodcock, Mound, Booth and Lorella soils occur. Hapgood and Hartig soils are also found in the Warner Mountains.

GEOLOGY

The oldest rocks within Goose Lake Basin are probably of Middle Miocene or early Pliocene age (Generalized Geology Map). This unit is thick and variable in composition. It is characterized predominantly by andesitic rocks, but also includes a section of rhyolitic and dacitic pyroclastics, minor basalt, palagonite tuff, and related tuffaceous sediments. These rocks are exposed over a large part of the basin. Total thickness of the pre-Pliocene-Tertiary sediments and volcanic rocks appears to exceed 13,000 feet.

Widespread extrusions of basalt flows followed the episode of predominantly acidic tuff deposition. These flows appear to be overlain by a complex system of sediments, tuffs, basalt flows and accumulations of cinders and other materials contemporaneous with the early phases of the building of large composite volcanic centers. Available data indicates that the lacustrine phase of deposition occurred approximately from Middle Miocene to Late Pliocene age. The eruptions at most volcanic centers appear to have ceased by the beginning of Pleistocene glaciation. Local intrusions and extrusions of rhyolite, dacite and andesite occurred in the eastern part of the area from early Pliocene to Pleistocene time.

Lacustrine deposition of Pleistocene age took place around the outer extremity of the Goose Lake floodplain. Deposition of alluvial deposits, including diatomite and peat, occurred during Holocene times around the edge of Goose Lake, forming the present floodplain area.

The following includes a definition of the lithologic units in the basin. The units selected are considered to be representative of major changes in depositional character.

Oligocene--early Miocene (Taf)

This unit includes andesitic and basalt flows, tuff, tuff breccia, and tuffaceous sedimentary rocks. The andesites are both porphyritic and nonporphyritic. The basalts are dark brownish-gray, vesicular and sometimes prophyritic. Both the basalts and the andesites are often greenish-brown in color. No complete section is known but the estimated thickness of the unit is in excess of 2500 feet.

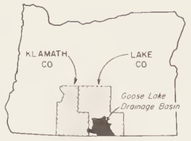
Middle Miocene-early Pliocene (Ttf)

This unit is thick and variable in composition in the basin. It is characterized by massive beds of light-colored rhyolitic and dacitic ash-flow tuffs containing abundant pumice rock fragments. These beds are overlain by a thick section of thin-bedded, weathered, vesicular porphyritic basalt and interbedded pumice-bearing tuffs and tuffaceous sediments. Thickness of this overall formation is

GENERALIZED GEOLOGY
GOOSE LAKE DRAINAGE BASIN
OREGON

SEPTEMBER 1977

SCALE 1:500,000 — 1 0 1 2 3 MILES



LOCATION MAP

GENERALIZED GEOLOGY

Holocene

Qal — Alluvial deposits including diatomite and peat

Pleistocene

Qt — Fluvial terrace and lacustrine deposits

Pliocene

Tlb — Olivine basalt porphyry and non-porphyritic olivine basalt flows and gray, vesicular diktytaxitic basalt flows.

Miocene-Pliocene

Ttf — Rhyalite-dacite ash-flow tuffs. Tuffaceous sedimentary racks, basalt and andesite flows, and palaganite tuffs.

Oligocene-Miocene

Taf — Tuffaceous sandstones, tuffs, and tuff breccias of andesitic composition, with andesite and basalt flows.

Tb — Basalt and diabase dikes and sills.

Tertiary-Quaternary

QTvcb, QTvcc, QTrd

- QTvcb – basalt eruptive centers
- QTvcc – basaltic cinder cones
- QTvrd – Extrusive and shallow intrusive bodies of light-colored racks ranging from rhyalite through andesite vitraphyre.
- QTrd – andesite, dacite, rhyolite dikes.

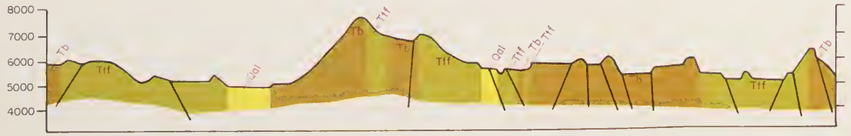
Fault, dashed where approximate

Photogeologic attitude

Anticline, dashed where approximate

Strike and dip of beds. (10)

GENERALIZED GEOLOGIC CROSS SECTION



Feet above Sea Level

Source:
Base map prepared by SCS, WTSC Carto Staff from USGS 1:24,000 quads.
Thematic detail compiled from Geologic Map of the Klamath-Lake Counties Region, Oregon.
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

M7-SN-23835-3

in excess of 12,000 feet, although the absolute base of the underlying Tertiary volcanic section is uncertain.

Pliocene (Tb)

Throughout the northern and eastern part of the basin, the Miocene-early Pliocene tuffs are overlain by basalt flows. Two basalt units have been recognized. The oldest includes olivine basalt porphyry and non-porphyritic olivine basalt with an observed thickness of 10 to 150 feet. The youngest basalt unit is light to medium gray, vesicular, and containing pyroxene, magnetite and olivine. Total thickness of the unit ranges from 20 to 600 feet.

Pleistocene - Holocene

Fluvial, terrace and lucastrine deposits (Qlo).

The Goose Lake depression received significant quantities of sediment during this time interval. The thickness of the lucastrine strata appears to exceed 1286 feet, based on available well data. The northernmost deposits contain many conglomerate beds probably representing stream and delta deposits at the margin of an earlier, expanded Goose Lake. General conditions of deposition suggest a middle to late Pleistocene age for the unit.

Alluvial deposits (Qal)

Deposits of sand, silt, mud and, in some cases, peat are being deposited in and around the Goose Lake area.

Late Tertiary and Quaternary (Qtvrd)

The usual occurrence of eruptive centers in the basin is as intrusive-extrusive domes. Rock types range from basalt to bodies of light-colored rocks ranging from rhyolite through andesite. Evidence at hand suggests that upward building of these volcanic centers ceased in the early Pleistocene, and the oldest age that can be assigned is probably late Miocene or early Pliocene. Rhyolite domes and andesite piles are younger with a radiometric age of 8.1 million years.

Geologic Structure

The main structural features of the Basin are normal faults. The predominant fault - strike direction is northwesterly, associated with a few faults with a northeasterly strike. This alignment indicates that the regional normal fault pattern was initiated during the Pliocene age. After the deposition of the Pliocene lucastrine materials and building of most of the eruptive centers, the entire area was apparently folded into broad, low amplitude

anticlines and synclines with the previously mentioned axial trend. The fault frequency and magnitude of displacement during post-Pliocene normal faulting appears to be a maximum along the area of probable anticlinal uplift and diminishes inward toward the central structural depression.

MINERAL RESOURCES

Mineral production in the Goose Lake Drainage Basin is limited at present to sand and gravel, stone, mercury and uranium. Claims have been filed on several uranium deposits but these are not in production at this time.

Two abandoned uranium mines exist on the forest lands in the Basin. These mines were closed in 1965.

Present energy costs have increased interest in geothermal water for heating, and electric generation. Several successful geothermal wells are in production for general heating. The potential for other successful geothermal wells appears good. Many areas on the east side of the basin have been leased to energy development companies for geothermal prospecting.

LAND RESOURCES

Soils

The general soil map shows areas of soils in a manner that is useful for land resource planning or land use planning. It is also useful in determining land suitability for such large scale projects as development of agricultural, urban and suburban areas, waste disposal facilities, and airport and manufacturing installations.

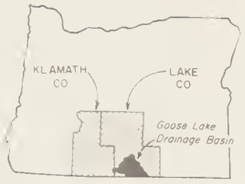
The mapping units on the general soil map consist of associations of soils and miscellaneous land types that occur in a more or less repetitive manner across the landscapes of the Basin. For the most part, soils within each association have properties in common, such as, depth, slope, wetness, stoniness, or alkilinity that allow useful interpretations to be made for broad scale planning. The map does not, however, show the individual kind of soil for site specific locations. Detailed soil surveys are needed for this purpose.

Table 2, titled Characteristics, Qualities, and Other Data of Soils, lists the soil associations, their component soils, estimated number of acres and the estimated percent of area occupied by major soils in the association, and suitabilities and limitations for a number of uses and purposes. It also gives the slope, position , elevation, climate, vegetation, some of the main soil properties and qualities, and the major present uses.

GENERAL SOIL MAP
GOOSE LAKE DRAINAGE BASIN
OREGON

OCTOBER 1977

SCALE 0 1 2 3 MILES



LOCATION MAP

SOIL ASSOCIATIONS

AREAS DOMINATED BY WARM, MODERATELY WELL TO POORLY DRAINED, NEARLY LEVEL SOILS ON LAKE BOTTOMS, FLOOD PLAINS, AND LOW TERRACES.

1. Calder - Pit association, 0 to 3 percent slopes
2. Crump - Ozamis association, 0 to 2 percent slopes
3. Icene - Lofftus - Dune land association, 0 to 25 percent slopes
4. Lakeview - Goose Lake - Ozamis association, 0 to 2 percent slopes
5. Scherrard - Stearns association, 0 to 1 percent slopes
6. Tandy - Ozamis association, 0 to 2 percent slopes

AREAS DOMINATED BY COLD, MODERATELY WELL TO VERY POORLY DRAINED, NEARLY LEVEL SOILS ON LAKE BOTTOMS.

7. Flagstaff - Unnamed - Dune land association, 0 to 25 percent slopes
8. Paulina - Chinchallo association, 0 to 1 percent slopes

AREAS DOMINATED BY WARM, WELL DRAINED, NEARLY LEVEL TO STEEP SOILS ON BASIN TERRACES AND TERRACE FRONTS

9. Salisbury - Bieber association, 0 to 35 percent slopes
10. Drews association, 0 to 2 percent slopes
11. Drews association, 2 to 35 percent slopes
12. Harriman - Hager association, 0 to 15 percent slopes

AREAS DOMINATED BY COLD, WELL TO EXCESSIVELY DRAINED, NEARLY LEVEL TO MODERATELY STEEP SOILS ON BASIN TERRACES AND LAVA TABLELANDS.

13. Bonnick association, 0 to 35 percent slopes
14. Fort Rock association, 0 to 2 percent slopes
15. Lobert association, 3 to 20 percent slopes
16. Morehouse - Bonnick - Fort Rock association, 0 to 2 percent slopes
17. Unnamed association, 0 to 15 percent slopes
18. Puls - Powley association, 0 to 7 percent slopes
19. Gordone - Unnamed association, 1 to 35 percent slopes

AREAS DOMINATED BY WARM, WELL DRAINED, VERY STONY SOILS SOILS ON GENTLE TO STEEP RIDGE SLOPES.

20. Lorello - Bluejoint - Booth association, 2 to 40 percent slopes

AREAS DOMINATED BY COLD, WELL TO EXCESSIVELY DRAINED, GENTLY SLOPING TO VERY STEEP SOILS ON RIDGES AND TABLELANDS.

21. Arron - Bonnick association, 2 to 25 percent slopes
22. Hapgood - Hartig association, 3 to 35 percent slopes
23. Booth - Bluejoint association, 2 to 40 percent slopes
24. Flake - Olson association, 0 to 8 percent slopes
25. Hart - Plush association, 1 to 35 percent slopes
26. Woodcock - Mound - Pokegema association, 5 to 60 percent slopes
27. Shanahan - Lapine association, 0 to 35 percent slopes

AREAS DOMINATED BY ROCK OUTCROP, PLAYAS, AND SAND DUNES

28. Rock land association
29. Playas association
30. Dune land
31. Lava flows

Each area mapped on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of parcels of land.

Source:
Base map prepared by SCS, WTSC Carto Unit from USGS 1:24,000 quads.
Thematic detail compiled by state staff.
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA SCS-PORTLAND OR 1977

M7-SN-23835-4

TABLE 2 Characteristics, qualities, and other data of soils, Goose Lake Drainage Basin, Oregon, 1976

Soil group and association				Soil Characteristics				
Name	Percent soils in assoc.	Position	Surface	Subsoil	Substratum	Surface Depth Inches	Reaction of Surface Soil (pH value)	Permeability
Areas dominated by warm, moderately well to poorly drained, nearly level soils on lake bottoms, flood plains, and low terraces:								
1. Calder-Pit association								
Calder silt loam (0-1% slopes)	60	Low terraces	Dark gray and dark grayish brown silt loam and silty clay loam	Dark grayish brown silty clay	Olive brown silt loam underlain by a hardpan	7	5.6 - 6.5	Very slow
Pit silty clay (0-3% slopes)	40	Drained lake bottoms flood plains and fans	Black silty clay	Black clay	Very dark gray silty clay	6	6.6 - 7.8	Slow
4. Lakeview-Goose Lake-Ozamis association								
Lakeview loam (0-1% slopes)	20	Floodplains	Black loam	Black and very dark brown silty clay loam and sandy clay loam	Very dark grayish brown and dark grayish brown sandy clay loam	4	6.6 - 7.8	Moderately slow
Lakeview silty clay loam (0-1% slopes)	20	Floodplains	Black silty clay loam	Black silty clay loam	Very dark gray and very dark grayish brown fine sandy clay loam and gravelly sandy loam	4	6.6 - 7.8	Slow
Goose Lake silty clay loam (0-1% slopes)	15	Floodplains, flat low terraces	Black and very dark gray silty clay loam	Black and very dark gray silty clay	Stratified loamy sand and clay	10	6.1 - 6.5	Slow
Goose Lake silty clay loam wet (0-1% slopes)	10	Floodplains, flat low terraces	Black silty clay loam	Black and very dark gray silty clay and silty clay loam	- -	9	6.1 - 6.5	Slow
Goose Lake silt loam (0-1% slopes)	5	Floodplains, flat low terraces	Black and very dark gray silt loam	Very dark gray silty clay	Very dark gray silty clay	10	6.1 - 6.5	Slow
Goose Lake loamy fine sand	2	Flat low terraces	Very dark gray loamy fine sand	Black and very dark gray silty clay loam and silty clay	Very dark gray silty clay	10	6-1 - 6.5	Slow
Ozamis loam (0-1% slopes)	10	Floodplains	Very dark gray loam	- -	Olive gray, dark olive gray and olive brown mottled sandy clay loam, silty clay loam and coarse sandy loam	13	6.1 - 6.5	Moderately slow
Ozamis silty clay loam (0-1% slopes)	10	Floodplains	Black silty clay loam	- -	Dark gray, very pale brown and dark gray mottled silt loam, coarse sand and very fine sandy loam	10	6.1 - 6.5	Moderately slow
5. Scherrard-Stearns association								
Scherrard very fine sandy loam (0-1% slopes)	35	Floodplains	Dark gray very fine sandy loam and loamy fine sand	Gray silty clay loam	Hardpan	8	7.4 - 7.8	Slow
Scherrard silt loam (0-1% slopes)	20	Floodplains	Black silt loam	Black, very dark brown and very dark gray silty clay loam and silty clay	Dark grayish brown silt loam	3	7.4 - 7.8	Slow
Stearns silt loam (0-1% slopes)	30	Low terraces	Dark gray silt loam	Very dark grayish brown and dark brown silty clay and heavy silty clay loam	Hardpan underlain by stratified silty, sandy, and clayey sediments	2	7.9 - 8.4	Slow
6. Tandy-Ozamis association								
Tandy loamy fine sand (0-1% slopes)	75	Beach and shore deposits	Very dark grayish brown loamy fine sand	- -	Gray and very dark grayish brown loamy fine sand and fine sandy loam, black and very dark brown silt loam and fine sandy loam	9	7.9 - 8.4	Moderately rapid
Ozamis loam (0-1% slopes)	25	Floodplains	Very dark gray loam	- -	Olive gray, dark olive gray and olive brown mottled sandy clay loam, silty clay loam and coarse sandy loam	13	6.1 - 6.5	Moderately slow
Areas dominated by cold, moderately well to very poorly drained, nearly level soils on lake bottoms:								
8. Paulina-Chinchallo association								
Paulina silty clay loam (0-1% slopes)	60	Lake bottoms	Black silty clay loam	- -	Dark gray, very dark gray and dark grayish brown silt, silty clay loam and sandy clay loam	10	6.6 - 7.3	Slow
Chinchallo silt (0-1% slopes)	30	Lake bottoms	Black silt	Very dark gray silt	Dark gray, light brown and brown silt and very gravelly coarse sand (pumiceous cinders and ash)	8	5.6 - 6.5	Slow in silty upper part, rapid through cindery lower part
Areas dominated by warm, well drained, nearly level to steep soils on basin terraces and terrace fronts:								
9. Bieber-Salisbury association								
Bieber gravelly loam (1-8% slopes)	40	Terraces	Very dark gray gravelly loam	Very dark brown, dark brown and dark yellowish brown clay loam and fine gravelly clay	Olive brown very gravelly hardpan	2	6.1 - 6.5	Slow
Salisbury loam (2-8% slopes)	20	Terraces	Very dark brown loam and fine sandy loam	Dark brown and olive brown clay loam, clay, gravelly clay and gravelly sandy clay loam	Dark grayish brown gravelly hardpan	10	6.6 - 7.3	Slow
Salisbury loam (8-15% slopes)	10	Terraces	Very dark brown loam and fine sandy loam	Dark brown clay	Gravelly hardpan	6	6.6 - 7.3	Slow

Hydrologic Group	Available Water Holding Capacity (in.)	Soil Qualities: Shrink-Swell Potential (Surface layer)	Drainage Class (Water Table - feet)		Runoff	Erosion Hazard	Elevation	Precipitation	Soil Environment: Air Temp (°F)	Frost Free Period (32° temp.) (Days/yr.)	Capacity Class and Subclass	Vegetation	Soil Use and Management: Major Land Use	Major Soil Problems or Limitations
D	2-6	Low	Moderately well	(> 6')	Slow to very slow	Slight	4100 - 5500	10-15	46-47	50-110	IV (IRR)	Sagebrush and bunchgrass	Irrigated grain and pasture, range, wildlife	Shallow to cemented pan, clay layers, slow internal drainage
D	9-11	High	Poorly	(0-4')	Very slow	Slight	4200 - 5000	8-15	46-49	50-100	IIIs (IRR)	Rushes and sedges	Irrigated grain and pasture, wildlife	Too clayey, wetness, floods
C	10-12	Moderate	Moderately well	(2 1/2-5')	Slow	Slight	4050 - 5000	13-15	46-47	75-135	IIw (IRR)	Sagebrush and bunchgrass	Irrigated grain, hay, pasture, wildlife	Wetness, floods
C	10-12	Moderate	Moderately well	(2 1/2-5')	Slow	Slight	4050 - 5000	13-15	46-47	75-135	IIW (IRR) (NIRR)	Sagebrush and bunchgrass	Irrigated grain, hay, pasture, wildlife dryland wheat and small grain	Wetness, floods
D	10-12	High	Poorly	(0-5')	Slow	Slight	4700 - 4800	13-15	46-47	50-100	IIIw (IRR)	Sedges, rushes and grasses	Irrigated hay, grain, pasture, wildlife	Wetness, floods
D	10-12	High	Very Poorly	(0-5')	Slow to ponded	Slight	4700 - 4800	13-15	46-47	50-100	Vw (IRR)	Sedges, rushes and grasses	Irrigated native hay, pasture, wildlife	Wetness, floods
D	10-12	Low	Poorly	(0-5')	Slow	Slight	4700 - 4800	13-15	46-47	50-100	IIIw (IRR)	Sedges, rushes and grasses	Irrigated hay, grain, pasture, wildlife	Wetness, floods
D	10-12	Low	Poorly	(0-5')	Slow	Slight	4700 - 4800	13-15	46-47	50-100	Vw (IRR)	Sedges, rushes and grasses	Irrigated native hay, pasture, wildlife	Wetness, floods
B/D	11-13	Moderate	Poorly	(0-3 1/2')	Very slow	Slight	4400 - 4800	8-15	46-49	50-100	Vw (IRR)	Rush, sedge and bluegrass	Irrigated native hay, pasture, wildlife	Wetness, floods
B/D	11-13	Moderate	Poorly	(0-3 1/2')	Very slow	Slight	4400 - 4800	8-15	46-49	50-100	Vw (IRR)	Rush, sedge and bluegrass	Irrigated native hay, pasture, wildlife	Wetness, floods
D	3-9	High	Somewhat poorly	(0-3 1/2')	Slow	Slight	4050 - 4725	10-15	46-49	50-110	IVw (IRR)	Saltgrass, rush, greasewood and rabbitbrush	Irrigated pasture, native hay, range, wildlife	Wetness, floods, excess salts, cemented pan
D	3-9	High	Somewhat poorly	(0-3 1/2')	Very slow	Slight	4050 - 4725	10-15	46-49	50-110	IVw (IkR)	Saltgrass, rush, greasewood and rabbitbrush	Irrigated pasture, native hay, range, wildlife	Wetness, floods, excess salts, cemented pan
D	3-8	Low	Somewhat poorly	(1-3')	Slow	Slight	2500 - 3000	13-15	46-47	50-80	IVw (IRR)	Wild rye, salt grass and related forbs and shrubs	Irrigated pasture, hay and grain, range, wildlife	Wetness, floods, excess salts, cemented pan
C	6-8	Low	Somewhat poorly	(0-3')	Very slow	Slight	4690 - 4725	13-15	46-47	50-80	VIe (NIRR)	Saltgrass, rush and foxtail grass	Range and wildlife	Wetness, floods, erosive
B/D	11-13	Moderate	Poorly	(0-3 1/2')	Very slow	Slight	4400 - 4800	8-15	46-49	50-100	Vw (IRR)	Rush, sedge and bluegrass	Irrigated native hay, pasture, wildlife	Wetness, floods
D	10-13	Moderate	Poorly	(0-3')	Very slow	Slight	4000 - 5000	8-10	42-45	10-50	Vw (IRR)	Sedge and rush	Irrigated native hay, pasture, range, wildlife	Wetness, floods
B/D	15-30	Low	Poorly	(0-3')	Very slow	Slight	4150 - 5000	16-30	41-43	10-50	Vw (IRR)	Sedge, rush, tufted hairgrass and bluegrass	Irrigated native pasture, range, wildlife	Wetness, floods
D	1 1/2-3	Moderate	Well drained	(> 6')	Slow to medium	Slight to moderate	4750 - 5000	13-15	46-47	70-110	IVe (IRR)	Sagebrush and bunchgrass	Irrigated pasture, hay, range, wildlife	Cemented pan, small stones, erosive
D	3-5	Moderate	Well drained	(> 6')	Medium	Moderate	4750 - 5000	13-15	46-47	70-100	IIIe (IRR) IIIs (NIRR)	Fescue, bluegrass, bluebunch wheat grass and shrubs	Irrigated and non-irrigated wheat and hay, range and wildlife	Cemented pan, erosive
D	2-5	Moderate	Well drained	(> 6')	Rapid	Severe	4750 - 5000	13-15	46-47	70-100	IVe (IRR) (NIRR)	Fescue, bluegrass, bluebunch, wheat grass and shrubs	Irrigated and nonirrigated wheat and hay range, wildlife	Cemented pan, slopes and erosion hazard

Soil group and association			Soil Characteristics					
Name	Percent soils in assoc.	Position	Surface	Subsoil	Substratum	Surface Depth Inches	Reaction of Surface Soil (pH value)	Permeability
Salisbury loam (15-35% slopes)	10	Terraces	Very dark brown loam and fine sandy loam	Dark brown clay	Gravelly hardpan	6	6.6 - 7.3	Slow
Salisbury loam (0-2% slopes)	10	Terraces	Very dark brown loam	Dark brown and olive brown clay loam, clay, gravelly clay and gravelly sandy clay loam.	Gravelly hardpan	10	6.6 - 7.3	Slow
10. Drews association, nearly level								
Drews loam (0-2% slopes)	35	Terraces and fans	Very dark brown loam	Very dark grayish brown and dark brown clay loam and gravelly clay loam	Dark yellowish brown gravelly loam	11	6.1 - 6.5	Moderately slow
Drews fine sandy loam (0-2% slopes)	25	Terraces and fans	Very dark brown fine sandy loam	Very dark brown and dark brown sandy clay loam and sandy loam	Dark yellowish brown gravelly loam	12	6.1 - 6.5	Moderately slow
Drews loam, gravelly substratum (0-2% slopes)	15	Basin Terraces	Very dark brown loam	Very dark grayish brown and dark brown gravelly sandy clay loam and clay loam, and gravelly clay loam and sandy clay loam	Very gravelly loam and sandy clay loam	12 - 14	6.1 - 6.5	Moderately slow
Drews variant loam (0-2% slopes)	15	Basin Terraces	Dark gray and dark grayish brown loam and fine sandy loam	Gravish brown sandy clay loam	Dark ayish brown sandy loam	14	6.1 - 6.5	Moderate
11. Drews association, gently sloping to steep								
Drews loam (2-8% slopes)	15	Terraces and fans	Very dark brown loam	Very dark grayish brown and dark brown clay loam and gravelly clay loam	Dark yellowish brown gravelly loam	11	6.1 - 6.5	Moderately slow
Drews fine sandy loam (2-8% slopes)	15	Basin Terraces	Very dark brown fine sandy loam	Very dark brown and dark brown sandy clay loam and sandy loam	Dark yellowish brown gravelly loam	12	6.1 - 6.5	Moderately slow
Drews loam (8-15% slopes)	10	Terraces and fans	Very dark brown loam	Very dark greyish brown and dark brown clay loam and gravelly clay loam	Dark yellowish brown gravelly loam	11	6.1 - 6.5	Moderately slow
Drews fine sandy loam (8-15% slopes)	10	Basin terraces	Very dark brown fine sandy loam	Very dark brown and dark brown sandy	Dark yellowish brown gravelly loam	12	6.1 - 6.5	Moderately slow
Drews loam (15-35% slopes)	10	Terraces	Very dark brown loam	Very dark grayish brown and dark brown clay loam and gravelly clay loam	Dark yellowish brown gravelly loam	11	6.1 - 6.5	Moderately slow
Drews loam, gravelly substratum (2-8% slopes)	10	Terraces	Dark grayish brown and very dark grayish brown loam and gravelly loam	Brown gravelly sandy clay loam and very gravelly clay loam	Very gravelly sandy clay loam and clay loam	12	6.1 - 6.5	Moderately slow
Drews variant loam (2-8% slopes)	10	Basin Terraces	Very dark brown loam	Dark brown sandy clay loam and clay loam	Hardpan	8	6.1 - 6.5	Moderate
Drews variant loam (8-15% slopes)	5	Basin Terraces	Very dark brown loam and fine sandy loam	Dark brown sandy clay loam and clay loam	Hardpan	8	6.1 - 6.5	Moderate
Areas dominated by cold, well to xcessively drained, nearly level to moderately steep oils on basin terraces and lava tablelands:								
15. Lobert association								
Lobert loam (3-20% slopes)	100	Terraces and terrace fronts	Very dark brown and dark brown loam	Dark brown loam and sandy clay loam	Dark brown loam	5	6.1 - 6.5	Moderate
18. Puls-Powley association								
Puls gravelly silt loam (1-7% slopes)	50	Fans and terraces	Dark brown gravelly silt loam	Dark brown and dark reddish brown silty clay loam and clay	Dark brown hardpan	2	6.1 - 6.5	Slow
Powley loam (0-2% slopes)	30	Terraces and benches	Very dark brown and very dark grayish brown loam	Dark brown clay loam and clay	Hardpan	9	6.6 - 7.3	Slow
Areas dominated by warm, well drained, very stony soils on gentle to steep ridge slopes:								
20. Lorella-Bluejoint-Booth association								
Lorella very stony loam (20-40% slopes)	35	Ridge slopes	Dark brown very stony loam	Dark brown gravelly clay loam and clay	ight and dark brown volcanic tuff	4	6.1 - 6.5	Slow
Lorella very stony loam (2-20%)	10	Ridge slopes	Dark brown very stony loam	Dark brown gravelly clay loam and clay	ight and dark brown volcanic tuff	4	6.1 - 6.5	Slow
Bluejoint very stony loam (5-40%)	20	Ridge slopes	Very dark brown very stony loam	Very dark brown, dark brown and yellowish brown and dark brown clay loam	Dark yellowish brown and yellowish brown loam underlain by dark brown weathered volc. tuff	7	6.1 - 6.5	Moderately slow
Booth very stony loam (20-40% So. slopes)	10	Tablelands and ridges	Very dark brown very stony loam	Dark brown clay	Soft tuffaceous bedrock	4	6.1 - 6.5	Slow
Booth very stony loam (2-20%)	10	Tablelands and ridges	Very dark brown very stony loam	Very dark brown and dark brown clay	oft tuffaceous bedrock	4	6.1 - 6.5	Slow

Soil Qualities									Soil Use and Management				
Hydrologic Group	Available Water Holding Capacity (in.)	Shrink-Swell Potential (Surface layer)	Drainage Class (Water Table - feet)		Runoff	Erosion Hazard	Elevation	Precipitation	Air Temp (°F)	Frost Free Period (32° temp.) (Days/yr.)	Capacity Class and Subclass	Vegetation	Major Land Use	Major Soil Problems or Limitations
D	2-6	Moderate	Well drained	(> 6')	Rapid	Severe	4750 - 5000	13-15	46-47	70-100	VIe	Wheat grass and shrubs	Range and wildlife	Cemented pan, excessive slope and erosion hazard
D	2-6	Moderate	Moderately well drained	(> 6')	Slow	Slight	4750 - 5000	13-15	46-47	70-100	IIIs (IRR) (NIRR)	Wheat grass and shrubs	Irrigated and non-irrigated wheat and hay, range and wildlife	Cemented pan
B	4.5-12	Low	Well drained	(3 1/2-5')	Slow	Slight	4700 - 5000	13-15	46-47	75-120	IIc (IRR) (NIRR)	Big sagebrush and bunch-grasses	Irrigated and non-irrigated grain, hay range and wildlife	Climate
B	4.5-12	Lo	Well drained	(3 1/2-5')	Slow	Slight	4700 - 5000	13-15	46-47	75-120	IIc IRR) (NIR)	Big sagebrush and bunch-grasses	Irrigated and non-irrigated grain, hay range and wildlife	Climate
B	5-7	Low	Well drained	(3 1/2-5')	Slow	Slight	4700 - 5000	13-15	46-47	75-120	IIc (IRR) (NIRR)	Big sagebrush and bunch-grasses	Irrigated and non-irrigated grain, hay range and wildlife	Climate
B	2.5-5.5	Low	Well drained	(3 1/2-5')	Slow	Slight	4700 - 5000	13-15	46-47	75-120	IIc (IRR) (NIRR)	Big sagebrush and bunch-grasses	Irrigated and non-irrigated grain, hay range and wildlife	Cemented pan, climate, erosive
B	4.5-12	Low	Well drained	(3 1/2-5')	Medium	Slight	4700 - 5000	13-15	46-47	75-120	IIc (IRR) (NIRR)	Big sagebrush and bunch-grasses	Irrigated and non-irrigated grain, hay (range and wildlife)	Climate
B	4.5-12	Low	Well drained	(3 1/2-5')	Medium	Slight	4700 - 500	13-15	46-47	75-120	IIe (IRR) IIc (NIRR)	Big sagebrush and bunch-grasses	Irrigated and non-irrigated grain, hay (wildlife, range)	Erosive, climate
B	4.5-12	Low	Well drained	(3 1/2-5')	Medium	Moderate	4700 - 5000	13-15	46-47	75-120	IIIe (IRR) (NIRR)	Big sagebrush and bunch-grasses	Irrigated and non-irrigated grain, hay irrigated pasture (range and wildlife)	Erosive, climate
B	4.5-12	Low	Well drained	(3 1/2-5')	Medium	Moderate	4700 - 5000	13-15	46-47	75-120	IIIe (IRR) (NIRR)	Big sagebrush and bunch-grasses	Irrigated and non-irrigated grain, hay irrigated pasture (range and wildlife)	Erosive, climate
B	4.5-12	Low	Well drained	(3 1/2-5')	Medium	Severe	4700 - 5000	13-15	46-47	75-120	IVe (IRR)	Big sagebrush and bunch-grasses	Irrigated hay and pasture (range and wildlife)	Excessive slope and erosion hazard, climate
B	5-7	Low	Well drained	(3 1/2-5')	Medium	Slight	4700 - 5000	13-15	46-47	75-120	IIc (IRR) (NIRR)	Big sagebrush and bunch-grasses	Irrigated and non-irrigated grain, hay, pasture (range and wildlife)	Climate
B	2.5-5.5	Low	Well drained	(3 1/2-5')	Medium	Moderate	4700 - 5000	13-15	46-47	75-120	IIIe (IRR) IIIs (NIRR)	Big sagebrush and bunch-grasses	Irrigated and non-irrigated grain, hay (range and wildlife)	Cemented pan, climate, erosive
B	2.5-5.5	Low	Well drained	(3 1/2-5')	Medium	Moderate	4700 - 5000	13-15	46-47	75-120	IVc RR IVe IRR	Big sagebrush and bunch-grasses	Irrigated and non-irrigated grain, hay and pasture (range and wildlife)	Cemented pan, climate, erosive
B	7-11	Low	Well drained	(2 1/2-4')	Slow to medium	Slight to severe	4200 - 5200	15-18	43-45	20-50	IVe (IRR)	Ponderosa pine, bitterbrush sedge and Idaho fescue	Irrigated pasture, woodland, rangeland wildlife	Erosive on upper slope breaks
D	2-5	High	Well drained	> 6')	Medium to rapid	Severe	5000 - 6000	8-12	42-45	10-50	VIe (NIRR)	Low sagebrush and bunch-grasses	Range and wildlife	Erosive cemented pan, small stones
D	1.5-4	Low	Well drained	> 6')	Slow	Slight	5000 - 6000	10-12	43-45	10-50	VIe (NIRR)	Low sagebrush and bunch-grasses	Range and wildlife	Cemented pan
D	1-3	Low	Well drained	(> 6')	Rapid	Severe	4140 - 6000	12-16	46-49	90-120	VIIs (NIRR)	Juniper, big sagebrush and bunchgrasses	Range, wildlife	Shallow bedrock, excess slope and erosion hazard, stony, too clayey
D	1-3	Low	Well drained	(> 6')	Rapid	Severe	4140 - 6000	12-16	46-49	90-120	VIIs (NIRR)	Juniper, big sagebrush and bunchgrasses	Range, wildlife	Shallow bedrock, excess slope and erosion hazard, stony, too clayey
B	6.5-13	Low	Well drained	(> 6')	Medium	Moderate	5000 - 6500	12-16	40-45	10-50	VIIs (NIRR)	Big sagebrush and bunchgrasses	Range and wildlife	Stony. excess slope and erosion hazard
C	2.5-7	Low	Well drained	(> 6')	Rapid	Severe	5000 - 6500	12-16	40-45	10-50	VIIs (NIRR)	Sagebrush and fescue	Range and wildlife	Stony, too clayey, excessive slope and erosion hazard
C	2.5-7	Low	Well drained	(> 6')	Rapid	Severe	5000 - 6500	12-16	40-45	10-50	VIIs (NIRR)	Sagebrush and fescue	Range and wildlife	Stony, too clayey, slope and erosion hazard

Soil group and association				Soil Characteristics				
Name	Percent soils in assoc.	Position	Surface	Subsoil	Substratum	Surface Depth Inches	Reaction of Surface Soil (pH value)	Permeability
Areas dominated by cold, well to excessively drained, gently sloping to very steep soils on ridges and tablelands:								
22. Hapgood-Hartig association								
Hapgood loam (3-35% slopes)	40	Ridges and hills	Very dark brown loam and gravelly loam	Very dark brown gravelly loam	Dark brown very gravelly loam	10	6.1 - 6.5	Moderate
Hartig gravelly loam (5-35%)	40	Southerly facing ridge and hill slopes	Very dark grayish brown gravelly loam	Dark brown gravelly loam	Dark yellowish brown very gravelly loam	9	6.1 - 6.5	Moderate
23. Booth-Bluejoint association								
Booth very stony loam (20-40% No. slopes)	25	Tablelands and ridges	Very dark brown very stony loam	Very dark brown and dark brown cla and silty clay	Weathered volcanic tuff	10	6.1 - 6.5	Slow
Booth very stony loam (20-40% slope)	20	Tablelands and ridges	Very dark brown very stony loam	Dark brown clay	Weathered volcanic tuff	4	6.1 - 6.5	Slow
Booth very stony loam (2-20%)	15	Tablelands and ridges	Very dark brown very stony heavy loam	Very dark brown and dark brown very cobbly clay and clay	Olive brown weathered volcanic tuff	4	6.1 - 6.5	Slow
Bluejoint very stony loam (5-40% No. slopes)	10	Ridges and hills	Very dark brown very stony loam	Very dark brown and dark brown heavy loam and clay loam	Dark yellowish brown and yellowish brown loam	12	6.1 - 6.5	Moderately slow
Bluejoint very stony loam (5-40% So. slopes)	10	Ridges and hills	Very dark brown very stony loam	Very dark brown, dark brown and yellowish brown clay loam	Dark yellowish brown and yellowish brown loam	7	6.1 - 6.5	Moderately slow
26. Woodcock-Mound association								
Woodcock stony loam (40-60% No. slopes)	40	Ridges	Very dark brown stony or bouldery loam	Dark brown very gravelly and cobbly loam and sandy clay loam	Dark brown very gravelly and cobbly loam	10	6.1 - 6.5	Moderate
Woodcock stony loam (5-40% So. slope)	15	Ridges	Very dark brown stony to very stony loam	Dark brown very gravelly and cobbly clay loam	Dark brown very gravelly and cobbly loam	12	6.1 - 6.5	Moderate
Mound stony loam (5-40% No. slopes)	25	Ridges	Very dark brown stony loam	Dark brown gravelly loam, and silty clay loam	Dark brown silty clay loam	7	6.1 - 6.5	Slow
Areas dominated by rock outcrop, playas, and sand dunes:								
28. Rock Land association								
Rock outcrop-Xerothents	80	Rock outcrop	- -	- -	- -	- -	- -	- -

Soil Qualities											Soil Use and Management		
Hydrologic Group	Available Water Holding Capacity (in.)	Shrink-Swell Potential (Surface layer)	Drainage Class (Water Table - feet)		Runoff	Erosion Hazard	Elevation	Precipitation	Air Temp (^{o}F)	Frost Free Period (32^{o} temp.) (Days/yr.)	Capacity Class and Subclass	Vegetation	Major Land Use	Major Soil Problems or Limitations
B	4-8	Low	Well drained	(> 6')	Medium	Moderate to Severe	6000 - 8000	11-15	36-44	10-50	VIIe (NIRR)	Big sagebrush and bunchgrass	Range and wildlife	Slope and erosion hazard, small stones
B	3.5-8.5	Low	Well drained	(> 6')	Medium	Severe	5000 - 6500	12-16	40-45	10-50	VIIe (NIRR)	Big sagebrush and bunchgrass	Range and wildlife	Slope and erosion hazard, small stones
C	2.5-7	Low	Well drained	(> 6')	Rapid	Severe	5000 - 6500	12-16	40-45	10-50	VIIs (NIRR)	Sagebrush and fescue	Range and wildlife	Stony, too clayey, excess slope and erosion hazard
C	2.5-7	Low	Well drained	(> 6')	Rapid	Severe	5000 - 6500	12-16	40-45	10-50	VIIs (NIRR)	Sagebrush and bunchgrass	Range and wildlife	Stony, too clayey, excessive slope and erosion hazard
C	2.5-7	Low	Well drained	(> 6')	Rapid	Severe	5000 - 6500	12-16	40-45	10-50	VIIs (NIRR)	Sagebrush and fescue	Range and wildlife	Stony, too clayey, slope and erosion hazard
B	6.5-13	Low	Well drained	(> 6')	Medium	Moderate	5000 - 6500	12-16	40-45	10-50	VIIs (NIRR)	Sagebrush and bunchgrass	Range and wildlife	Stony, excess slope and erosion hazard
B	6.5-13	Low	Well drained	(> 6')	Medium	Moderate	5000 - 6500	12-16	40-45	10-50	VIIs (NIRR)	Sagebrush and bunchgrass	Range and wildlife	Stony, excess slope and erosion hazard
B	3-7	Low	Well drained	(> 6')	Medium	Severe	5000 - 6500	18-25	42-44	20-50	VIIe (NIRR)	Pine and fir	Timber, range and wildlife	Excess slope and erosion hazard, stony
B	3-7	Low	Well drained	(> 6')	Medium	Moderate	5000 - 6500	18-25	42-44	20-50	VIIe (NIRR)	Pine and fir	Timber, range and wildlife	Excess slope and erosion hazard, stony
C	5-10.5	Low	Well drained	(> 6')	Rapid	Severe	5000 - 6500	16-24	40-45	10-50	VIIe (NIRR)	Pine, fir and sedge	Timber, range and wildlife	Excess slope and erosion hazard, stony
- -	- -	- -	- -	- -	- -	- -	4500 - 7000	10-25	- -	- -	VIIs	Juniper, sage, bunchgrass	Range and wildlife	Excess slope and erosion hazard, stony

The map was prepared from detailed soil surveys made in the County over the past decade and from a recent reconnaissance type soil survey made jointly by SCS and Oregon State University. Recently prepared geological and topographic surveys were used in adjusting map unit boundary lines in certain outlying areas where it seemed appropriate. Most of the detailed soil surveys were made on cropland with comparatively minor areas surveyed on range and woodland areas. Therefore, a correspondingly greater degree of accuracy exists on the cropland areas compared to range and woodland areas on the soil map. The lines drawn on the map, as well as the units of mapping and associated soils, must be considered tentative and subject to change as more is learned about the soils of the area.

Land Ownership

Goose Lake Drainage Basin includes 464,270 acres of land and water (Land Ownership Map) (Table 3). The largest single landholding in the Basin is vested in the federal government with 183,340 acres, or 39.5 percent of the study area. There are 39,300 acres (8.5 percent) in other public ownership including State, county, and municipal. The state acreage includes 31,070 acres of Goose Lake, while municipal acreage includes 1,720 acres within the city limits of Lakeview, Oregon. The balance of 241,630 acres, or 52.0 percent of the Basin, is in private ownership.

Federal ownership includes 180,820 acres of the Fremont National Forest, administered by the Forest Service out of Lakeview. The other 2,520 acres in Federal ownership are public domain lands administered by the Bureau of Land Management, also out of Lakeview.

Timber industry ownerships account for 24,410 acres of the private lands. Most of the balance of 217,220 acres are in rancher ownerships.

Land Cover

Land cover of the Goose Lake Drainage Basin is the vegetative condition or lack thereof at the time (June 28, 1976) the LANDSAT satellite passed over. Table 4 describes these in terms of broad categories not to be confused with land-use categories which are also discussed in the following section.

Data was obtained from the LANDSAT program developed at Oregon State University. This program (PIXSYS) identifies all pixels (1.12 acres) with similar vegetative, water, or bare soil characteristics. These similar clusters were located on U-2 color IR photography cross checked by on-the-ground sampling, and described to meet study needs. The data presented in this and subsequent sections concerning land cover and use is derived from the LANDSAT

Table 3.--Land Status, Cover and Land Use. Goose Lake Drainage Basin, Oregon 1976

Status and Ownership	Rangeland[1]	Pasture	Cropland	Forest Land	Rock	Urban	Other Water[2]	Roads[3]	Total
			Acres						
Federal:									
Dept. of Agriculture Forest Service	11,570			167,370	160		1,100	620	180,820
Dept. of Interior Bureau of Land Management	170		140	1,820	90		290	10	2,520
Total Federal	11,740		140	169,190	250		1,390	630	183,340
Other Public:									
State	340			440			31,070	160	32,010
County and Municipal	1,710		1,160	1,480		1,720	50	1,170	7,290
Total Other Public	2,050		1,160	1,920		1,720	31,120	1,330	39,300
Private									
Timber Industry	2,020			22,280	20		10	80	24,410
Other	102,470	48,270	43,090	17,790	490	170	4,520	420	217,220
Total Private	104,490	48,270	43,090	40,070	510	170	4,530	500	241,630
GRAND TOTAL	118,280	48,270	44,390	211,180	760	1,890	37,040	2,460	464,270

1/ Includes 12,000 acres of cobble surface range.
2/ Includes all surface water bodies exceeding 4 acres.
3/ Includes only permanent roads.
4/ Includes 31,070 acres of Goose Lake.

Table 4.--Land Cover vs. Land Use, Goose Lake Drainage Basin, Oregon, 1976

Land Cover Designation	Acres Total	Land Use Designation							
		Forest	Range	Pasture	Cropland	Rock	Other Urban	Other Roads	Other Water
Forested	205,850	199,720	5,390	- -	- -	- -	- -	740	- -
Rock	12,760	- -	12,000	- -	- -	760	- -	- -	- -
Water	8,020	- -	- -	- -	- -	- -	- -	- -	8,020
Brush	85,140	2,560	81,570	- -	- -	- -	- -	1,010	- -
Grass	27,720	- -	14,510	10,580	2,220	- -	- -	410	- -
Cultivated Crops	66,210	- -	- -	27,240	36,780	- -	1,890	300	- -
Bare Soil	8,240	- -	4,460	- -	3,780	- -	- -	- -	- -
Riparian Vegetation	9,080	- -	- -	9,080	- -	- -	- -	- -	- -
Unclassified	3,770	- -	350	1,370	1,610	- -	- -	- -	440
Omitted	37,480 1/	8,900	- -	- -	- -	- -	- -	- -	28,580
TOTAL	464,270	211,180	118,280	48,270	44,390	760	1,890	2,460	37,040

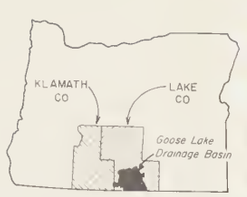
1/ Includes 28,580 acres of Goose Lake

Source: LANDSAT (PIXSYS) program (Table 27 Appendix)

LAND OWNERSHIP
GOOSE LAKE DRAINAGE BASIN
OREGON

DECEMBER 1977

SCALE 1:250,000



LOCATION MAP

LAND OWNERSHIP

- National Forest, Administered by Forest Service
- Public Domain, Administered by BLM
- County and Municipal
- Timber Industry
- State of Oregon
- Other Ownership

Source:
Base map prepared by SCS, WTSC Carto Unit from USGS 1:24,000 quads.
Thematic detail compiled by state staff.
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA SCS PORTLAND OR 1977

M7-SN-23835-1

program. In using the following acreages, the user must remember that this was the land cover condition on the date of the satellite coverage.

There were 205,850 acres with 10 percent or more tree cover; 12,760 acres of rock; 8,020 acres of water surface; 85,140 acres of brush; 27,720 acres of grasses; 66,210 acres of cultivated crops; 8,240 acres of bare soil, 9,080 acres of riparian vegetation; 3,770 acres unclassified; and 37,480 acres omitted from the satellite telemetry, including Goose Lake.

Acreages are summarized and assigned to land-use category in Table 4.

The Basin is divided into two broad vegetational zones consisting of subhumid areas dominated by forest and semiarid areas in which a shrub-bunchgrass vegetative cover predominates. The forest zone includes two areas. One area consists of the northerly slopes and higher elevation southerly slopes of ridges and peaks making up the Warner Mountains. The other area occurs along the west side of the Basin and includes the lava plateau and peaks lying west of the Goose Lake Valley. Within each area, the forest zone also encloses large shrub-bunchgrass tracts which primarily occur on shallow and moderately deep soils having clayey subsoils. A number of mountain meadows having a sedge, rush and grass cover are also scattered within this zone.

Principal trees in the forest zone include ponderosa pine, white fir, incense cedar, aspen, and Lodgepole pine. Understory shrubs mainly include snowbrush, snowberry, bitterbrush, currant and manzanita. Bunchgrasses, principally Idaho fescue, occur in openings between trees on many lower elevation, southerly slopes. Ponderosa pine occurs in nearly pure stands on most southerly slopes below 6000 feet elevation. Ponderosa pine with various proportions of white fir occurs on many southerly slopes above 6000 feet and on northerly slopes. Lodgepole pine occurs on some high elevation slopes in both the Warner Mountains and Gearhart Mountain areas. Aspen groves generally occur on the more moist sites at elevations above 5500 feet.

The shrub-bunchgrass zone occupies most of the basins tablelands and ridges lying east of the forest zone. Big sagebrush and bitterbrush are the principal shrubs on well drained tablelands, basin terraces and ridge slopes with Idaho fescue and bluebunch wheatgrass comprising two of the more important grasses. Low sagebrush occurs mainly on tablelands and ridge slopes having shallow soils with clayey subsoils. Poorly drained areas within basins consist of wet meadows, alkali flats and playas. Wet meadows typically have a plant cover of rushes, sedges and grasses. Alkali flats commonly have greasewood, rabbitbrush, saltgrass, and giant wildrye. Playas have little or no plant cover.

Land Use

Land-uses are identified in this report as cropland, forest land, rangeland, and other lands. Cropland is strictly a land-use category which implies tillage and/or cultivation. Forest land is a cover designation which includes those lands with at least a 10 percent stocking of trees (including noncommercial species such as juniper) and the lands from which these trees have been harvested. Rangeland relates primarily to areas of grassland or other long-term forage with less than 10 percent stocking of trees.

The "other" land category includes water, urban, rock, and roads. Water is those water bodies which were large enough (4 acres or more) to be detected and measured by the satellite on June 28, 1976. Urban is that area within the city limits of Lakeview and 340 farmsteads. Only permanent roads are included in the "other" estimate.

Soils producing timber also have associated recreation, wildlife and grazing uses. In addition, minerals are found in certain parts of the timbered areas and are potential sources of uranium mercury and other materials. Ponderosa pine is the principal tree, producing saw logs which are processed by mills located in Lakeview, Paisley and Bly.

Ranching and farming are primarily geared to raising beef cattle and a few bands of sheep. Most of the grazing land is privately owned land. Ranching is commonly carried out in conjunction with farming operations in which hay and feed are produced on irrigated land for winter feeding. Lands lying above developed irrigation water supplies in Goose Lake valley are used to grow dryland winter wheat, pasture and alfalfa. The major irrigated crops include alfalfa, wheat, oats, barley, and pasture.

Recreation is a rapidly growing segment of the economy. Tourism, hunting, fishing, camping, hiking, and rock and artifact collecting provide the chief recreational opportunities.

Most of the soils of the Basin produce varying amounts of runoff water which is used for irritation and to provide water for domestic and livestock consumption. Some of the water formerly emptying into shallow lakes within basins is now impounded in upstream reservoirs where it is used for flood control, recreation and irrigation.

A large number of game animals inhabit almost every part of the Basin. The larger animals include deer, antelope and a small band of big horn sheep. Quail, pheasant, sage grouse, and doves are included among the upland game birds. A wide variety of waterfowl inhabit the lakes and marshy areas.

CROPLAND RESOURCES

A total of 92,660 acres were classified as cropland and pasture in 1976 in the Goose Lake Drainage Basin (tables 4 and 5). Non-irrigated small grains accounted for 15,074 acres (table 5). All of the other crops, 77,586 acres, can be classified as hay and pasture, including 16,120 acres of irrigated small grains that are periodically plowed and seeded to grass-legume mixtures.

The "non-irrigated land" classification includes 38,766 acres of poorly drained and often naturally sub-irrigated lands (1,550 acres of alfalfa; 15,591 acres of grass hay and pasture; 12,025 acres of meadows; and 9,600 acres of wheat grass)(table 5). There are small acreages of miscellaneous crops and other land uses included in with the hay and pasture land. Examples include a field of mint and a golf course. With the exception of areas that are planted to grain and about 2,190 acres of poor condition grass pasture, the cover on all lands is generally in good condition.

Table 5.--Estimated Acreage of Irrigated and Non-Irrigated land and of Crops, Goose Lake Drainage Basin, Oregon, 1976

Cropland and Crops	Area
	Acres
Irrigated land:	
Alfalfa	6,110
Grass hay and pasture	15,770
Meadows	820
Small grains	16,120
Total irrigated	38,820
Non-irrigated land:	
Alfalfa	1,550
Grass hay and pasture	15,591
Meadows	12,025
Small grains	15,074
Wheat grass	9,600
Total non-irrigated	53,840
Total cropland crops	92,660

SOURCE: LANDSAT (PIXSYS) program.

FOREST LAND RESOURCE

The forest land vegetative types identified by the PIXSYS system are as follows:

1. Ponderosa Pine Types
   a. Pure Pine
   b. Pine Dominant

2. Ponderosa Pine-White Fir Codominant

3. White Fir Dominant

4. Lodgepole Pine
   a. Pure Pine
   b. Pine Dominant

5. Clearcuts and Old Burns

The PIXSYS system has not addressed eco-zone delineations and it is doubtful that direct correlations can be developed. Indicator species of eco-zones are often under a dense tree canopy in which the tree species are not indicative of the climax community. The indicator species may not be detected by LANDSAT. The eco-zone may be fir-sedge, however, the system has identified it as lodgepole pine because the pine now occupies the site following an old fire.

The same can be said of range eco-classes or habitat types. The system identifies existing vegetation which may be the result of overgrazing or of range improvement such as seeding.

Pure Ponderosa Pine Type:

This type includes four and possibly five of the ponderosa pine associations described by Franklin and Dyrness in Technical Report PNW-8, 1973. Ponderosa pine, including sugar pine, is the dominant species. Incense cedar is associated with the stands in the southwest portion of the Basin, often comprising as much as 10 percent of the canopy. Scattered white fir and lodgepole pine are also present. Juniper may be associated with the ponderosa pine at elevations below 5,500 feet and precipitation of less than 15 inches.

The actual composition will vary from 100 percent pure pine to about 80 percent pine and 20 percent associated species. The composition of the timber stand is dependent upon the location, soils, elevation, aspect and history of disturbance such as fire. Ponderosa pine is generally climatic in the pure pine type. Stands are open-grown with fair to good ground cover of grasses including Idaho fescue and bluebunch wheatgrass, shrubs such as bitterbrush and snowberry, and forbs such as yarrow and balsamroot.

The pure ponderosa pine type is generally found on the warmer sites between elevations of 4,800 feet and 6,600 feet. Soils are moderately shallow, coarse textured, and sandy with more than 10 inches of precipitation. There are 88,840 acres of commercial forest land in the pure pine type.

Ponderosa Pine Dominant Type:

This type is found on the upper climatic edge of the ponderosa pine associations. The stands are generally on the northerly benches at middle elevations and lower gentle slopes of north aspects. Soils are moderately deeper, finer textured, and a little cooler than the pure pine type.

Ground cover tends to be denser with more brush and forb species and a greater variation with some of the species associated with the fir zone coming in. It is questionable whether ponderosa pine will remain the dominant species. A long, wet, cool weather cycle could favor fir invasion. Logging will tend to maintain an open stand and favor ponderosa pine.

There are 71,940 acres of commercial forest in the pine dominant type.

Ponderosa Pine - White Fir Codominant

Ponderosa pine and white fir comprise 80 percent or more of the timber stand with ponderosa being slightly more prevalent. These stands occupy portions of the fir zone. The understory is dominantly associated species with little, if any, ponderosa pine. The pine has most likely been an invader due to fire or some other ecological setback.

The balance of the overstory is an associated mix of white pine and lodgepole pine. Ground cover is dominated by low shrubs with some grasses and sedges. There are about 23,560 acres of commercial forest land in this type.

Lodgepole Pine Dominant:

These are associated species stands in which lodgepole pine is the dominant species at this time. Lodgepole is an invader on these sites and is on its way out. Understory trees are mostly white fir and the balance of the overstory is white fir with an occasional ponderosa pine. Ground cover is mostly low shrubs and scattered grasses and sedges. These types are generally found on gentle westerly slopes at middle to upper elevations. There are about 3,000 acres of this type in the Basin.

Lodgepole Pine Type:

Lodgepole pine (includes whitebark pine at extreme elevations) comprises 80 percent or more of the timber stands. White fir and an occasional ponderosa pine make up the balance. These stands generally occupy cool, moist sites with poorly drained soils of middle to upper gentle to flat northerly to easterly facing slopes. Ground cover is limited to sparse low shrubs, forbs, and scattered grass plants. Many of these stands are decadent with many dead or dying trees. White fir tends to invade these sites. There are 1,640 acres of this type in the Basin.

White Fir Dominant:

White fir comprises 50-80 percent of the tree canopy. Ponderosa pine and lodgepole pine make up the balance. These stands are generally found from mid-to-upper gentle slopes with northeast to northwest aspects. These stands are mostly old-growth of decadent trees. Ground cover is mostly good with shrubs 2 feet to 4 feet dominating. There are 19,540 acres of this type in the Basin.

Clearcuts and Burns:

Clearcutting has mostly been limited to white fir and lodgepole pine types. Some difficulty has been experienced in reforesting a few of the lodgepole pine areas because of loss of shallow nutrient layers to water and wind erosion. Invading brush also may become a problem. There are three areas--the Cox Creek Burn, the Camp Creek Burn, and a smaller area near Fish Lake where very hot fires destroyed the forest cover. Some portions of Cox Creek, much of Camp Creek, and all of the Fish Lake fire have severe ceanothus brush problems. Some cultural treatment to release the planted trees has shown success. There is still much to be done.

There are 2,660 acres of clearcuts and burns all within the pure ponderosa pine type with tall brush 4 feet to 10 feet tall. There are also about 40,000 acres of PIXSYS class "R" covered in the pure pine type which have either been burned or logged heavily. These areas are now occupied by low brush, reproduction, and a scattered overstory of mature ponderosa pine.

RANGE RESOURCES

Rangeland will be discussed on the basis of the PIXSYS system and by site type. PIXSYS describes the existing vegetation while site descriptions describe the site potential. The two may or may not be the same, however, no attempt has been made to relate the two.

Mountain Meadow Forest Range:

The mountain meadow sites are all within the forest resource zone. These are the meadows which exist along stream courses, particularly in the upper reaches near the origin of the streams. Very wide meadows often exist near the heads of the streams in this Basin.

Meadows which have been relatively undisturbed have a climax vegetative community typified by hairgrass, fescue, bluegrasses, sedges, rushes, astor, butterweed, and bistort. Most meadows however, have had extensive grazing, some even overgrazing, and many of the climax species are now gone, often with an invasion of sagebrush along the dryer parameter and small hummocks that exist along the edge of many meadows. There are 7,800 acres of forest wet meadow range. Four thousand four hundred and thirty acres of this type have been overgrazed or otherwise damaged and are now almost devoid of vegetation. These areas may have severe erosion problems and often are the source of head cutting that develops into severe gully erosion.

Mountain meadow range may be the key to management of forest ranges. The highest carrying capacity[17] is here and cattle tend to congregate on or near the meadows. This may lead to deterioration of the site if overuse is prolonged. Managerial strategy is designed to move livestock off of the meadows through salt location, off-site water development, herding, and fencing.

Brush-Grass Forest Range:

Range included in this category includes all areas in which the forage is dominated by brush species. These range sites are mostly on the open southerly exposed slopes in the pure pine type and the gentle slopes adjacent to many of the larger meadows. There are also areas known as scab ridges which were clustered with the sagebrush-grass range type. These are flats on top of ridges with shallow, cobbly soils and usually underlaid by a hardpan. These sites support only sparse vegetation composed of bluegrass, forbs, and low sagebrush.

Most of the brush-grass range has a fair to good cover of grasses with Idaho fescue the dominant species. Other grasses include bluebunch wheatgrass, blue wildrye, junegrass and Sandberg bluegrass. Big sagebrush and bitterbrush are the most prevalent brush species while forbs include yarrow, lupine, and cinquefoil.

The brush-grass range type includes areas dominated by the presence of a high percentage of rock on the surface (cobblestones). This is a low productive site which may or may not have some tree cover. The rock has the greatest influence on identification, masking the influence of vegetation.

Brush-grass ranges are also valuable forage sources for wildlife. Most of the browse is produced on these sites and it is located at elevations which remain available during most winters. Water is usually in short supply and requires development. There are 77,260 acres of these range sites.

Juniper Range:

Juniper range occupies a transition zone which lies between the forest resource area and the shrub-grass resource area. Western juniper is the dominant tree species. An occasional ponderosa pine can be found near stream bottoms or on north slopes where the soil moisture tends to last longer.

Big sagebrush is the most abundant shrub in the understory. Bitterbrush tends to replace big sagebrush on the better sites. Other species include rabbitbrush and low sagebrush. Bluebunch wheatgrass and Idaho fescue are the most common grasses. Most of these sites have been heavily grazed and forbs are more prevalent now than originally. These include mountain dandelion, yarrow, and fleabane.

The juniper range provides key winter range for mule deer and grouse. This is particularly true during severe winters which occur often in the Basin. There are 5,360 acres of this type in the Basin.

Range Resource Management

Grazing is an important land use in much of the Goose Lake Drainage Basin. An estimated 6000-7000 cattle and 1000-1500 sheep make use of the range resource annually for all or part of the grazing season. In addition, deer, antelope and a few elk also depend on the range forage and cover resource through part or all of the year.

Range forage is utilized from a variety of plant communities. These communities have developed in response to a wide variety of environmental conditions encountered in the Basin. They can be correlated with various climatic conditions found there along with certain soil and topographic conditions.

The native vegetation (discussed in the next section) is described on the basis of vegetative zones (see vegetation map) characterized by grass, shrub, juniper communities under natural conditions. Most of the productive soils in the Grassland and Shrub Grassland zones have been converted to agricultural, urban or industrial uses and only an estimated 20-30 percent remain in natural cover. Most of the Juniper zone remains in some form of native cover.

Range livestock use the Basin during a grazing season that ranges from about 3 to 7 months. The low elevation (warm, dry) Juniper,

Shrub, and Grassland zones have the longest period suitable for grazing (up to 7 months), ranging from late April through November. Except for meadow sites, however, grazing on rangeland in these zones is limited primarily to late spring when forage quality is the highest. The Juniper and Shrub zones are also important as the primary winter range for mule deer.

Nearly all rangeland is in private ownership, and it provides the bulk of the spring range.

Native Vegetation

The discussion to follow describes, in general, the type of vegetation characterizing each vegetation zone shown on the Potential Native vegetation map. This discussion includes descriptions of both the original vegetation (or potential) before disturbance by man as well as the general appearance of existing (disturbed) native stands.

Grassland (Bottomland) Zone

This zone is estimated to have occupied about 15 percent of the Goose Lake Drainage Basin. It is characterized by grassland ecosystems which occupy bottomland or low terrace positions. Shrubs were minor or absent in the original (climax) grass communities found here. However, certain shrubs such as silver sagebrush, big sagebrush and rabbitbrush are now abundant in the highly disturbed native stands found on certain soils. This zone includes the lowest elevations of the watershed and is the primary cropland-irrigated pasture section within the watershed.

The range sites that occur here are listed below. See table 6, "Plant Composition of Range Sites" for species associated with each site.

Major Sites	Minor in Occurrence
Wet Meadow *	Semi-wet (Oatgrass) Meadow *
Dry Meadow *	
Well-drained Bottom *	Moise Sodic Bottom (probably minor)
Moist Alkaline Bottom	

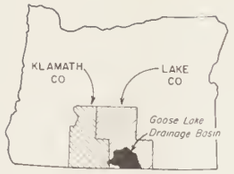
The major soil groups associated with these range sites according to the General Soil Map are:

1. Lakeview - Goose Lake - Ozamis association
2. Scherrard - Stearns association
3. Tandy - Ozamis association
4. Drews association (0-2% slopes)

* See table 6

POTENTIAL NATIVE VEGETATION
GOOSE LAKE DRAINAGE BASIN
OREGON

SEPTEMBER 1977



LOCATION MAP

LEGEND

(See repart narrative for zone description and plant community ar range site lists.)

- Farest Zone
- Juniper-Shrub Zone
- Shrub Grassland
- Grassland (Bottomland)
- Water
- White areas in Forest Zone represent lorge areas of non-farest vegetation containing range sites represen-tative af the Juniper, Shrub ar Grassland Zanes.

FOREST ZONE

SHRUB GRASSLAND ZONE

JUNIPER-SHRUB ZONE

GRASSLAND ZONE

FOREST ZONE

FREMONT NATIONAL FOREST

DREWS RESERVOIR

GOOSE LAKE

CALIFORNIA

Source:
Base map prepared by SCS, WTSC Carta Unit from USGS 1:24,000 quads.
Thematic detail compiled by state staff.
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA-SCS PORTLAND, OR 1977

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Table 6.--Plant Composition of Range Sites Goose Lake Drainage Basin, Oregon Watershed 1977

RANGE SITES	DOMINANT SPECIES IN POTENTIAL (CLIMAX) PLANT COMMUNITY	PLANT COMPOSITION OF DETERIORATED OR ALTERED STANDS
Bottomland sites dominated by grass and grass-like plants		
Wet Meadow	Tufted hairgrass, minor amounts of reedgrass, sedges, mannagrass, willows, aspen.	Sedge, mdw. barley, bluegrass dominate; Iris often prominent; dry meadow plants present if severely eroded.
Semi-wet Meadow	Calif. oatgrass; minor amounts of bluegrass and various forbs	Bluegrass and/or forbs become abundant
Dry Meadow	Bluegrass; minor amounts of silver sagebrush, sl. whtgr. and other grasses	Silver sagebrush dominates; herbaceous plants very sparse or weedy forbs common
Well drained Bottom	Giant wildrye, occassional big sagebrush and bitterbrush	Big sagebrush and rabbitbrush dominate; Giant wildrye absent or sparse; cheatgrass and weeds common
Moist Alkaline Bottom	Giant wildrye and Gray Rabbitbrush; minor amounts of saltgrass and greasewood	Gray rabbitbrush and minor amounts of greasewood dominate, G. wildrye sparse or minor
Moist Sodic Bottom	Giant wildrye, saltgrass, greasewood, some hopsage (Grsp)	Greasewood and saltgrass abundant but giant wildrye absent or minor
Upland sites characterized by presence of shrubs		
Clayey Terrace	Low sagebrush and Idaho fescue (non-stony soil)	Fescue is replaced by Sandberg bluegrass, cheatgrass and squirreltail; low sagebrush may become sparse
Shrubby Rolling Hills	Big Sagebrush and bitterbrush with I. fescue and bluebunch wheatgrass	Big sagebrush and rabbitbrush dominate stand; cheatgrass, needlegrass, Sandberg bluegrass and weeds are abundant
South Exposure (High Elev. phase)	Big sagebrush and bluebunch whtgr.; Some th. needlegrass, blue wildrye, and mtn. brome; mtn. mahog., plum and other shrubs present, esp. on Ialus area	Shrubs absent or sagebrush and/or rabbitbrush dominating; cheatgrass and weeds abundant
North Exposure	Idaho fescue; minor amts. of bitterbrush, big sagebrush, chokecherry, giant wildrye, gooseberry, plum, serviceberry, snowberry	Big sagebrush, rabbitbrush and cheatgrass or weeds common; scattered juniper may invade site
Mahogany Rockland	C. Mt. Mahogany with scattered pine and juniper, minor amounts of numerous shrubs. (Primarily bedrock outcrops)	Sagebrush, rabbitbrush and other shrubs become dense in places; cheatgrass and weeds are common
Very Cobbly Land	Low sagebrush and I. fescue, with scattered juniper (soil surface very stony)	Juniper may be absent because of fires; sandberg bluegrass and squirreltail replace I. fescue

Table 6--continued

Upland sites dominated by shrubs and juniper		
Juniper Rolling Hills	Juniper, bitterbrush, b. sagebrush, bluebunch wheatgrass, I. fescue, Th. needlegrass	Juniper sparse or very dense; b. sagebrush and rabbitbrush abundant; cheatgrass, sandberg bluegrass and weeds dominate.
Steep Juniper South Exposure	Scattered juniper; big sagebrush, bitterbrush, bluebunch wheatgrass, th. needlegrass; (Lallus shrub areas)	Juniper may be nearly absent due to fires, b. sagebrush and rabbitbrush abundant, cheatgrass common

Source: SCS Range Site Descriptions and field observations.

Shrub Grassland Zone

This zone is estimated to occupy about 10 percent of the Goose Lake Drainage Basin. The native vegetation is characterized by the presence of shrubs and is treeless or nearly so. Topographically, the zone comprises old terraces and low hills of the valley floor. It is dissected, frequently, by creeks and by bottomland associated with these creeks. Consequently, numerous inclusions of bottomland range sites from the Grassland Zone are found within the Shrub Grassland Zone. Climatically, this area along with the Grassland Zone probably represents the driest portion of the Basin which may account for its treeless nature. Farming and grazing have eliminated or significantly altered the original vegetative cover in many places, but much of the zone is still occupied by native species.

Range sites that occur here are listed below. See Table 6, "Plant Composition of Range Sites" for species associated with each site.

Major Sites	Minor in Occurrence
Shrubby Rolling Hills	Inclusions of Sites from Grassland Zone (those with an asterisk)
Clayey Terrace *	
Very Cobbly Land	

* See Table 6.

The major soil groups associated with these range sites according to the General Soil Map are:

1. Salisbury-Bieber association
2. Drews association (2-35% slopes)

Juniper-Shrub Grassland Zone

This zone is estimated to occupy almost 25% of the Goose Lake Drainage Basin. The general aspect of the zone is one dominated by juniper, although fires have eliminated or reduced the cover of juniper in numerous places where it is probably adapted. Climatically, the area is too dry for forest vegetation, although pine is found associated with juniper where environmental condtioins are the most favorable. Topographically, it occupies old terraces, low hills and steep slopes in and adjacent to the valley floor. The landscape is dissected frequently by creeks with bottomland soils that support vegetation typical of the Grassland Zone.

Listed below are the range sites that occur here. See the table "Plant Composition of Range Sites" for species associated with each site.

Major Sites	Minor in Occurrence
Juniper Rolling Hills	North Exposure
Steep Juniper South Exposure	Mahogany Rockland
Juniper-Pine-Bunchgrass	Inclusions of Grassland and Shrub Sites (those with asterisk)

The major soil groups associated with these range sites according to General Soil Map are:

1. Salisbury - Bieber association
2. Drews association (2-35% slopes)
3. Booth - Bluejoint association
4. Other shallow stony soils (unclassified)

Forest Zone

The highest precipitation occurs in the Forest Zone which is estimated to occupy about fifty percent of the Goose Lake Basin. The aspect of this zone is one comprized of mountains with forest cover, although there are many occurrences of non-forest vegetation throughout the zone. Ecologically, the potential vegetation for the sites (ecosystems) of this zone is forest, except where local environmental conditions (primarily soil factors) restrict forest development. Consequently, numerous inclusions of juniper sites, shrub sites or meadows normally found in other zones are common. Also, fires and/or logging have temporarily converted some areas from forest to treeless brush fields.

Range Condition

The Goose Lake Drainage Basin has had a long history of livestock use dating back to the 1860's or 1870's when the first settlers brought cattle into the Basin and began making use of the valley floor and open grasslands within the Forest Zone. Since then livestock use has been heavy and deer numbers have probably increased. Exploitation and development by man have initiated and/or maintained unnatural changes in the native vegetation such as those resulting from logging, farming, grazing, range improvement projects, and fire control. These factors have had and will continue to have a major impact on the condition of the range resource.

Range condition is sometimes thought of as a measure of the "health" of a particular type of rangeland. Actually, it is an indication of how similar the present vegetation of a site is to the potential for that site. Undisturbed rangeland producing essentially what it did before being affected or disturbed by man (seldom encountered today) is considered the climax or potential for the site and represents excellent condition. The greater the degree of departure from the potential (climax), or the greater the difference between the original vegetation and that existing on a site today, the lower the condition rating will be. Rangeland in poor condition has a species composition much different from the original, often dominated by invader species which may be less palatable to livestock. Condition class designations are not used on lands which have been purposefully seeded to non-native forage species.

A survey of the condition of the range resource has not been made for the entire Basin. However, surveys made at several locations and numerous observations made throughout the watershed indicate that most of the non-forest range is in fair or poor condition, with a few areas still in good condition. This means that in many range areas, especially those in poor condition, the present vegetation bears little resemblance to the original.

OTHER LAND RESOURCES

The "other" land category includes areas other than crop, pasture, forest, or range lands. These amount to 42,150 acres or 9 percent of the Basin. Four and one-half percent of the "other" land is urban, farmsteads, industrial areas, and airports. Roads and railroads comprise 2,460 acres or 5.8 percent of the "other" land. Seven hundred sixty acres or 1.8 percent of the "other" land is Class VIII which is generally suitable only for recreation, water supply, wildlife, or aesthetic purposes. Almost 90 percent of the "other" land is water area. The acreage and extent of this land use category in the Goose Lake Drainage Basin is shown in Table 7.

Table 7.--Estimated Acreages of "Other" Land, Goose Lake Drainage Basin, Oregon 1976

"Other" land category	Amount acres	Extent percent
Urban, farmsteads, industrial areas and airports	1,890	4.5
Roads and railroads	2,460	5.8
Rock (Class VIII)	760	1.8
Water	37,040	87.9
Total	42,150	100.0

Source: USDA River Basin Staff.

WATER RESOURCES

Surface Water

The average annual precipitation at Lakeview is 14.32 inches. Average monthly precipitation ranges between one and two inches during the nine months of October through June and is even less during the remaining months of July, August and September. During the growing season, total precipitation averages slightly more than two inches.

Most of the precipation which occurs from October to March is in the form of snow. Snow usually lies all winter in the higher timbered slopes but disappears after each snowstorm in the open valleys. Mean annual snowfall ranges from 15 inches in the valleys to over 70 inches on the mountains.

Most of the Basin's water supply originates on the mountains lying along the western boundary of the basin and on the Warner Mountains. The larger streams draining these uplands have been gaged for relatively long periods.

Average annual yield of the principal streams, correlated from records shere available and estimated where records are lacking, totals 128,800 acrefeet. Table 8 gives a breakdown of this total by subbasins and streams.

Table 8.--Yields of principal streams, Good Lake Drainage Basin, Oregon

Streams	Average annual yield
	Acre-feet
Antelope	
Antelope Creek*	2,400
Cogswell Creek*	3,300
Cottonwood Creek	14,700
Crane Creek*	3,300
Drews Creek	54,400
Dry Creek	9,500
Kelley Creek*	3,600
Muddy Creek	5,600
Thomas Creek	32,000
Basin total	128,800

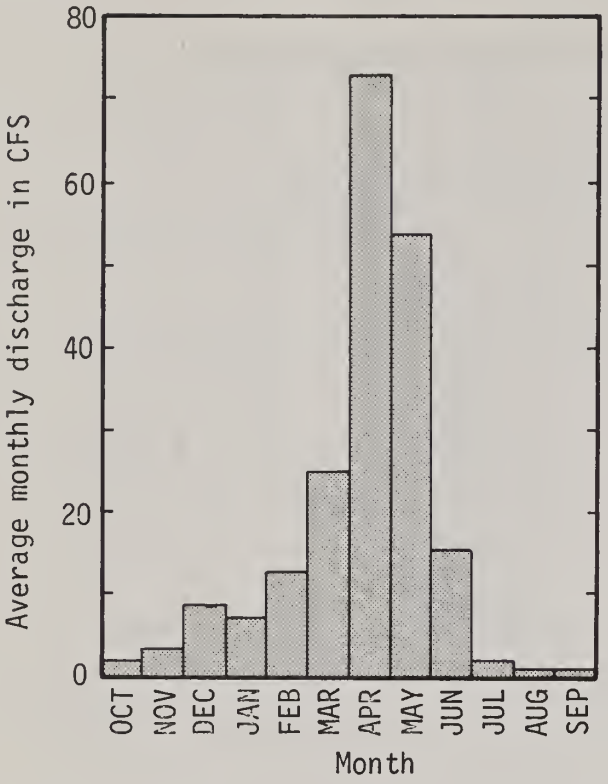
* Estimated values

Source: USGS Water Supply Papers, Oregon State Engineer records, Oregon State Water Resources Board correlations

Streamflows undergo pronounced seasonal changes. Peak flows usually coincide with the period of snowmelt, March and April. Flows begin to diminish in May and become negligible by late summer and early fall. Many streams go dry during this period.

This seasonal pattern is illustrated by Figure 4 which shows the distribution of annual yield for Thomas Creek in terms of average monthly discharge. For this stream, March, April and May are the months of highest discharge during which time nearly 75 percent of the annual yield occurs. Extremes in annual yield recorded for basin streams are listed in Table 9.

FIGURE 4 -- Thomas Creek Near Lakeview.



Average monthly discharge of Thomas Creek near Lakeview (mile 19.5), 1912-17, 1928-31 and 1946-58.

Data Source: U.S. Geological Survey

FIGURE 5.--Basin Precipitation - Runoff Correlation

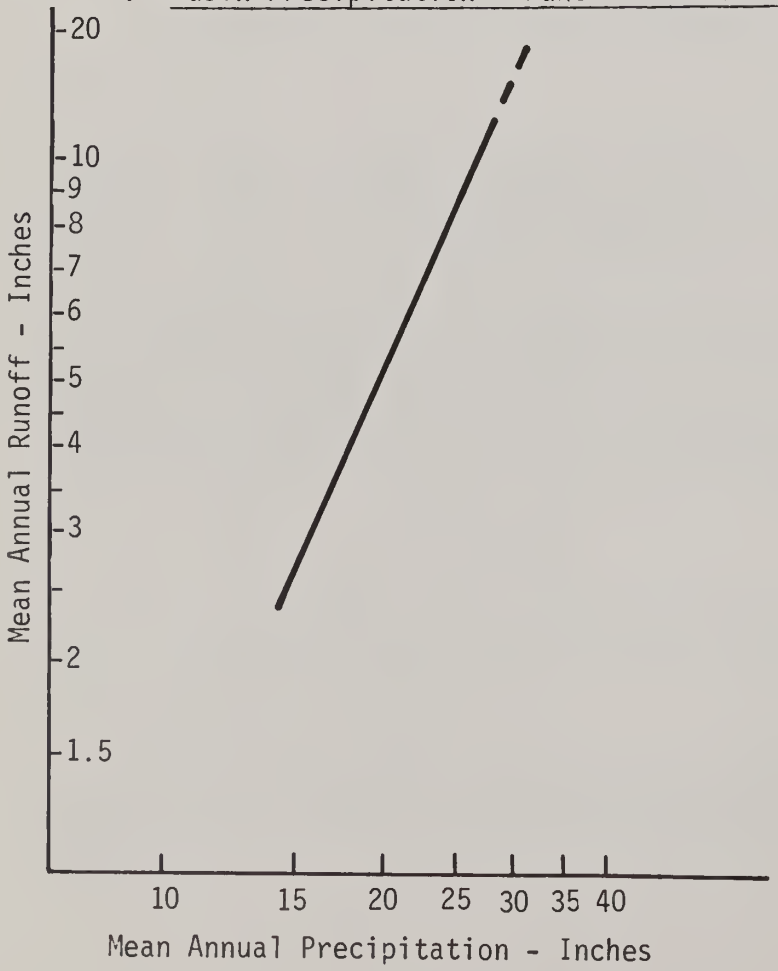


Table 9.--Extremes of Yield, Goose Lake Drainage Basin, Oregon

Stream	Years of Record	Annual yield	
		Minimum	Maximum
		Acre feet	
Cottonwood Creek	1920-1960	1,349	41,159
Drews Creek	1920-1960	5,200	169,041
Thomas Creek	1920-1960	2,830	28,677

Data Source: USGS Water Supply Papers, State Engineer records, Oregon State Water Resources Board correlations.

Low summer flows in most of the basin's streams restrict irrigation development and thereby limit full utilization of the basin's land resources.

Table 10.--Water yield, Goose Lake Drianage Basin, Oregon

Elevation Zone	Area	Mean runoff	Mean Annual Runoff
Feet	Acres	Feet	Acre-Feet
4000'	181,565.00	.158	28,687.27
		Total unforested land	28,687.27
4500'	10,000.84	.208	2,080.17
5000'	52,887.54	.233	12,322.80
5500'	88,318.48	.292	25,789.00
6000'	72.245.54	.360	26,008.39
6500'	39,627.70	.410	16,247.36
7000'	15,715.41	.480	7,543.40
7500'	3,909.49	.570	2,228.41
		Total forested land	92,219.53
		Total Basin	120,906.80

Source: Hydrologic Analysis for Forested Lands, Goose Lake Drainage Basin USFS 1977

Groundwater

Groundwater in the basin generally exists within a shallow water table although intermittent areas of confined water are present. Based on limited information, the regional water table is graded to a base level approximately equal to that of the major valley drainages.

Regional structure and the distribution of rock types largely prevent diversion of groundwater into or out of the Basin. The well developed fault system controls the movement of groundwater and quite often is repsonsible for the presence of confined aquifers.

There are four principal water-bearing rock units within the Basin area. The oldest unit is the volcanic rocks underlying the Pliocene sediments. These include basalt, andesite, rhyolite and

associated tuff and lucastrine deposits. They have been gently folded and severely faulted. In general, these rocks are only moderately porous and in the upland areas yield little or no water. Below the valley fill they yield moderate to large amounts of water.

The overlying sedimentary rocks of Pliocene age include mostly fine-grained, lake-type deposits of clay, silt, sand and gravel with interbedded volcanic tuff and flow rocks. In general, these beds have been slightly deformed by folding and faulting. The coarser zones yield small, moderate or large quantities of water that in places is confined and flows at the ground surface.

Older, fine-grained alluvial deposits of Pleistocene age in the central part of the valley areas consist of clay, silt, sand and gravel with some diatomaceous earth and volcanic ash. In places, minor faults cut the deposits. Generally, these materials are water bearing below the local water table but only the coarse-grained materials produce a large quantity of water. This condition occurs irregularly near the edge of the formation.

Younger alluvium of Recent age consists of clay, silt, sand and gravel with some volcanic ash and peat. It occurs principally in the central part of the main valleys as fine silt and clay and as deposits that underly the basin areas in the uplands. The deposits are generally coarser near the mouths of streams. These materials are saturated below the local water table. They provide adequate water for stock and domestic use. Some wells in coarse grained zones yield sufficient water for irrigation use.

Water Use and Management

Irrigation is the major use of water in the Basin. The primary irrigated crops are grass pasture and hay, alfalfa hay and small grain. The source of water for the irrigated cropland is as follows: reservoir storage facilities, and natural streamflow, 31,800 acres; and groundwater, 7,000 acres. Those acres irrigated from streamflow seldom receive a full season supply of water. The shortage of water in the latter part of the irrigation season has led to the practice of applying large quantities of water early in the season.

In addition to the irrigated cropland, approximately 8,600 acres of wet meadowland in the Basin are considered to be irrigated. The irrigation method consists of spreading the spring runoff over the land, a form of wild flooding. A map which shows the areas of irrigated land and potentially irrigable land in 1977 follows.

Reservoirs

Table 11, Reservoirs, Goose Lake Drainage Basin was developed from the records of the Oregon State Water Resources Department.

Table 11.--Reservoirs Goose Lake Drainage Basin, Oregon, 1977

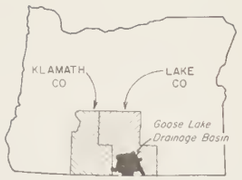
Name	Storage capacity	Surface area	Location		
	Ac. Ft.	Acres	Township	Range	Section
Drews Reservoir	63,568	4,520	40S	18E	5
Renner Dam	7,410	540	41S	18E	17
Cottonwood Reservoir	8,740	690	38S	19E	29
Muddy Creek Reservoir	1,400	180	39S	19E	7
Dallas Lake Reservoir	920	94	38S	16E	10
White Rock Reservoir	589	79	37S	20E	26
Cottonwood Meadow Reservoir	250	40	38S	18E	7
South Arm Reservoir		94	40S	16E	22
Renner Diversion Reservoir	43	14	40S	19E	17
Goose Lake Res. (Thomas Cr.)		240	40S	20E	16
Unnamed	4.5		41S	19E	5
Unnamed	2.3		38S	20E	23
Unnamed	3.7		38S	20E	23
Farleigh's Folly Reservoir	4.0	3	39S	19E	35
Unnamed	6.2		38S	20E	16
Unnamed	10.0		38S	20E	28
Bill's Stock Pond	7.4		38S	18E	10
Stock Pond #4	3.8		38S	19E	33
Stock Pond #3	3.5		39S	19E	5
Stock Pond #1	4.0		39S	19E	3
Stock Pond #2	4.5		39S	19E	5
Stock Pond #5	2.3		39S	19E	4
Fenimore Reservoir		12	39S	19E	31
Hammersly Canyon Cr. Reservoir		1	39S	20E	4
Hill Reservoir		14	39S	18E	24
Fish Lake		6	38S	18E	32
Dog Lake		205	40S	17E	15
Stover Reservoir		1	40S	19E	7
Thunder Egg Lake		1	40S	21E	16
Willow Creek Reservoir		7	40S	18E	5

Source: Oregon State Water Resourced Department

IRRIGATED AREA, 1977
GOOSE LAKE DRAINAGE BASIN
OREGON

MARCH 1978

SCALE 1:208,000



LOCATION MAP

LEGEND

- Irrigated Area, 1977
- Potential Irrigable Area

Source:
Base map prepared by SCS, WTSC Carta Unit from USGS 1:24,000 quads.
Thematic detail compiled by state staff.
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA-SCS-PORTLAND, OR. 1978

M7-SN-23835-7

Water Rights

Water within the State of Oregon from all sources are declared by statute to belong to the public. Subject to existing rights, all public waters within the State excepting those which may have been withdrawn by legislative action or by order of the Water Resources Department, may be appropriated for beneficial use by complying with the requirements of the Surface Water Code or the Ground Water Act 1/.

Oregon is essentially and appropriation-doctrine state, and the terminology "riparian rights" has been disregarded. In cases brought before the Oregon Supreme Court, it has been held that the 1909 Water Code abrogations of the common law riparian rule is valid except where the water has actually been applied to beneficial use prior to its enactment which, in effect, makes it an appropriative right.

The acreage of cropland with existing water rights has been tabulated. Approximately 85 percent of the cropland has surface-water rights and 15 percent has ground-water rights. In addition, irrigation water has been developed to supplement late season irrigation in areas which have insufficient supplies. Surface water rights for all uses are summarized in Table 12 and groundwater rights are summarized in Table 13.

1/ State Engineer of Oregon, Water Rights, 1966.

Table 12.--Surface-water rights summary, Goose Lake Drainage Basin, Oregon, 1977

Type	Amount
	cfs
Consumptive use:	
Domestic	0.845
Municipal	1.500
Irrigation	896.766
Industrial	4.030
Sub-total	903.141
Non-consumptive use:	
Power	- -
Mining, Recreation	0.224
Wildlife	- -
Fish Life	0.010
Sub-total	0.234
Total	903.375

1/ Acreage with water rights: 40,093.29 acres.
Source: Oregon State Water Resources Department

Table 13.--Ground-water rights summary, Goose Lake Drainage Basin, Oregon 1977

Type	cfs
Consumptive use:	
Domestic 1/	0.010
Municipal	8.240
Irrigation 2/	84.517
Industrial	5.200
Recreation	- -
Total	97.967

1/ A water right is not required for a domestic well from which less than 15,000 gallons per day is obtained or for a well used to irrigate less than one-half an acre.
2/ Acreage with water rights: 6,972.79 acres.

Source: Oregon State Water Resources Department

RECREATIONAL RESOURCE

Natural Features

Goose Lake Drainage Basin has a variety of natural features which are recreationally desirable. The Basin is bounded on the west, north, and east by forested slopes and on the south by Goose Lake. The forested portion is mostly within the Fremont National Forest. Much of the recreational activity takes place here in the forest setting with its many lakes, reservoirs, and small mountain streams.

The central part of the Basin is a broad, flat valley of grassland, brushland, marshes, and cropland with Goose Lake at the foot of the valley. There are a few hot springs in the area. Exploration has revealed some potential for geothermal energy. One such site was drilled several years ago resulting in a hot geyser near a local dining facility.

Goose Lake Drainage Basin has a variety of wildlife species throughout. There has been little habitat enhancement for nongame species; however, habitat conditions which favor game species also are favorable to many nongame species.

Wildlife populations finding suitable habitat in the Goose Lake Drainage Basin include mule deer, pronghorn antelope, bear, cougar, bobcat, coyote, badger, raccoon, skunks, beaver, weasels, muskrat, squirrels, rabbits, porcupine and many small rodents; ring-necked pheasant, California quail, mountain quail, blue and ruffed grouse, sage grouse, chukar partridge, doves, crow, raven, magpie, jays, robin and many kinds of small birds. Predator birds include hawks, owls and golden eagle. Vultures are seasonally abundant. Waterfowl includes geese, ducks, coot, and numerous shore birds. Sandhill crane and herons are also present.

Wildlife is discussed under the headings of big game, upland game, waterfowl, and furbearers.

Big Game

Mule deer, pronghorn antelope, black bear, and cougar are the principal big game animals found in Goose Lake Drainage Basin. An occasional Rocky Mountain elk may stray into the Basin from adjoining basins.

Mule deer is by far the most abundant and widespread big game animal. A good mix of open-grown and dense forest environment with adjacent shrub and grass-shrub areas favor large populations of deer. This mix provides the necessary cover for rearing and resting along with sufficient forage to carry the deer yearlong without extensive migration.

Table 14 gives deer harvest for the Goose Lake and Summer Lake basins, 1964-1968.

Table 14.--Mule Deer Harvest, Goose and Summer Lakes Basins

	Year				
	1964	1965	1966	1967	1968
	Number				
Hunters	11,560	11,830	11,320	11,200	10,850
Harvest	7,520	5,840	6,740	6,680	5,515
Hunter Days	59,790	60,870	60,460	40,290	58,500

Source: Oregon Department of Fish and Wildlife

There are a limited number of pronghorn antelope found in the valley. These small bands occupy the sagebrush and juniper environments, mostly in the upper valley. Black bear and cougar are principally forest dwellers and are not abundant.

Water requirements of big game are most critical during the dry summer season. A few water developments have been constructed for these animals. Providing additional perennial water supplies in habitat otherwise suitable for wildlife could make some segments of the Basin more productive.

Upland Game

Ringneck pheasant, chukar partridge, valley and mountain quail, sage grouse, blue and ruffed grouse, and mourning dove are the upland game birds of the Basin.

Ringneck pheasant, valley quail, and mourning dove are primarily valley bottom inhabitants, making extensive use of agricultural crops, and the improved cover and water provided in these areas. Chukar partridge and sage grouse occupy the rim rock or desert plateau habitat.

Blue and ruffed grouse are forest dwellers. They spend their winters on higher, wind-swept ridges but prefer creek bottoms and lowlands during the nesting and young chick stage.

Water supplies have the greatest impact on limiting populations of upland wildlife. This is particularly true for chuckar partridge and sage grouse. Some effort to develop water supplies has alleviated

part of the problems. There still remains much habitat which is only lightly populated during the limited wet periods in the spring and fall. Otherwise, these areas are avoided by wildlife dependent upon adequate water.

Ringneck pheasants provide considerable hunting in the basin. The cold climate and short growing season is somewhat limiting the pheasant populations. For hunter harvest see Table 15.

California Quail are generally associated with agricultural lands and provide only limited hunting. See table 15.

Doves provide good hunting early in the season (September), however, these migratory birds rapidly leave the area when the first frosts appear. See table 15.

Table 15.--Upland Game Harvest, Goose and Summer Lake Basins, Oregon

	Year			
	1966		1967	
	Hunter-Days	Harvest	Hunter-Days	Harvest
Ringneck Pheasant	2,475	2,156	3,706	2,552
Quail	1,510	3,060	2,726	7,626
Chukar Partridge	394	34	549	84
Sage Grouse	1,284	1,164	No season	No season
Mourning Dove	605	3,023	632	2,920

Source: Oregon Department of Fish and Wildlife

Waterfowl

Nearly all species of waterfowl in Oregon use the Goose Lake Drainage Basin's excellent waterfowl habitat during spring and fall migrations or for nesting in spring and summer (Table 16). Waterfowl numbers reach a peak in late October or early November. The spring migration through the Basin, however, is substantial.

The marsh areas around Goose Lake can provide substantial nesting when adequate water exists. The most common nesting species are mallard, cinnamon teal, pintail, gadwall, redhead, and ruddy duck. Many other water birds rely on the marshlands for resting and nesting. One of the most unusual species is the greater sandhill crane. When adequate water levels exist, they nest in the Basin. The lesser sandhill crane also utilizes the Basin on its spring and fall migrations.

Table 16 .--Ducks, Geese, and Swans: Goose Lake Drainage Basin

Puddle ducks	Diving ducks	Geese	Others
Mallard	Scoup	Snow	Swan
Pintail	Ruddy Duck	Canada	Hooded Merganser
Baldpate	Canvasback	White-Fronted	Common Merganser
Shoveler	Redhead	Ross'	
Gadwall	Bufflehead		
Green-Winged Teal	Ring-Necked Duck		
Cinnamon Teal	Goldeneye		
Blue-Winged Teal			
Wood Duck			

Source: Oregon Department of Fish and Wildlife

One of several important facotrs determining bird use of Goose Lake Basin is water level. Water supplies regulate the amount of habitat available for nesting. During the fall, water levels of the marshes regulate the amount of area and its attractiveness for resting birds. Total marsh area changes substantially from year-to-year. A year like 1977 can be quite devastating on waterfowl populations. Very little habitat was available. Diseases were severe and the young more exposed to predators.

Furbearers

Fifteen species of furbearers occur in the Goose Lake Drainage Basin. Beaver, muskrat, mink, otter, and raccoon occupy streams and lake environment or adjoining habitat. Martin, fisher, striped and spotted skunk, red and kit fox, badger, bobcat, coyote, and weasel are less water oriented, but are found in areas where their daily water needs can be satisfied.

Water requirements of furbearers, particularly species inhabiting aquatic environments, are the most critical. Lake and stream levels, water distribution, and water quality are key elements affecting the populations of these animals. The summer of 1977 was particularly hard on furbearer populations.

Fishes

Game Fish -- Rainbow trout, the most abundant and most widely distributed game fish, are present in nearly all waters capable of sustaining them. Brook trout are more limited due to their requirement for cooler water. They are most common in high elevation streams and lakes.

Table 17.--Fish Distribution, Goose Lake Drainage Basin, Oregon

Location	Type of Fish											
	Rainbow Trout	Brook Trout	Kokanee	Bullhead Catfish	Crappie	Largemouth Bass	Yellow Perch	Bluegill	Pumpkinseed	Roach	Dace	Suckers
Cottonwood Meadow Lake	X	X	X									
Cottonwood Reservoir	X	X										X
Dog Lake	X			X	X	X	X	X	X	X	X	X
Drews Reservoir	X			X			X			X		X
Fish Lake	X									X		
Goose Lake	X									X		X
South Arm Reservoir	X									X		
Drews Creek	X									X	X	X
Thomas Creek	X									X	X	
Cox Creek	X									X	X	
Bauers Creek	X									X	X	

Source: Oregon Department of Fish and Wildlife

Salmon are not native to this Basin, since it is naturally isolated from the ocean. However, kokanee have been introduced into Cottonwood Reservoir.

Low elevation lakes and ponds are principal habitat of bullhead catfish, crappie, perch, sunfish, and largemouth bass. Fish distribution is presented in Table 17.

Nongame Fish -- Nongame fish populations include roach, dace, and suckers. Roach are the most widely distributed, being found in most lakes and streams.

Nongame fish exhibit tremendous population increases when water conditions are favorable.

Recreation Facilities

Tourists and recreationists entering Goose Lake Valley find a variety of facilities available to them. There are several motels and restaurants for those who wish comfort and total service. Campgrounds and picnic sites are strategically located for those who wish to get out and rough it.

There are ten sites and areas with four boat launch facilities, 92 camp units, and 68 picnic units. The developed capacity in persons at one time is 800 (Table 18).

Hunting is by far the greatest outdoor recreation activity in Goose Lake Basin. This is true of Lake County as well. Records of use are not kept on a Basin basis; however, use for Lake County is indicative of use in the Basin. Recent recreational use activity records indicate that hunting of various wildlife accounts for an estimated one-third of the man-days of recreational activity in the County.

Other outdoor uses and activities include fishing, camping, skiing, and picnicking.

Table 18.--Recreation Developments, Goose Lake Drainage Basin, Oregon 1977

Site and owner	Boating	Camp Units	Picnic Units
		Number	
Goose Lake State Park	X	48	10
Chandler State Park	-	12	22
Booth Memorial State Park	-	-	9
Drews Reservoir	X	-	-
Thomas Creek, Forest Service	-	6	-
Cougar Creek, Forest Service	-	8	-
Beaver Dam, Forest Service	X	-	12
Cinder Hill, Forest Service	-	5	-
Dog Lake, Forest Service	X	13	2
Drews Creek, Forest Service	-	-	13
TOTAL	4	92	68

Source: USDA River Basins Staff

ECONOMIC DEVELOPMENT

ECONOMIC DEVELOPMENT

GENERAL DESCRIPTION

Historical Development

During the first half of the nineteenth century, early appraisals of the Lake County area were made by parties sent out by the federal government and by fur trader representatives of the Hudson Bay Company. Later, the basin was traversed by prospectors following gold discoveries in the John Day and Powder River regions. Not until 1867 did the first immigrants settle in the basin. By 1880, Lake County population was 2,804[1/] persons and stayed at about 2,800 persons until the early 1900's when settlement began increasing more rapidly.

Population

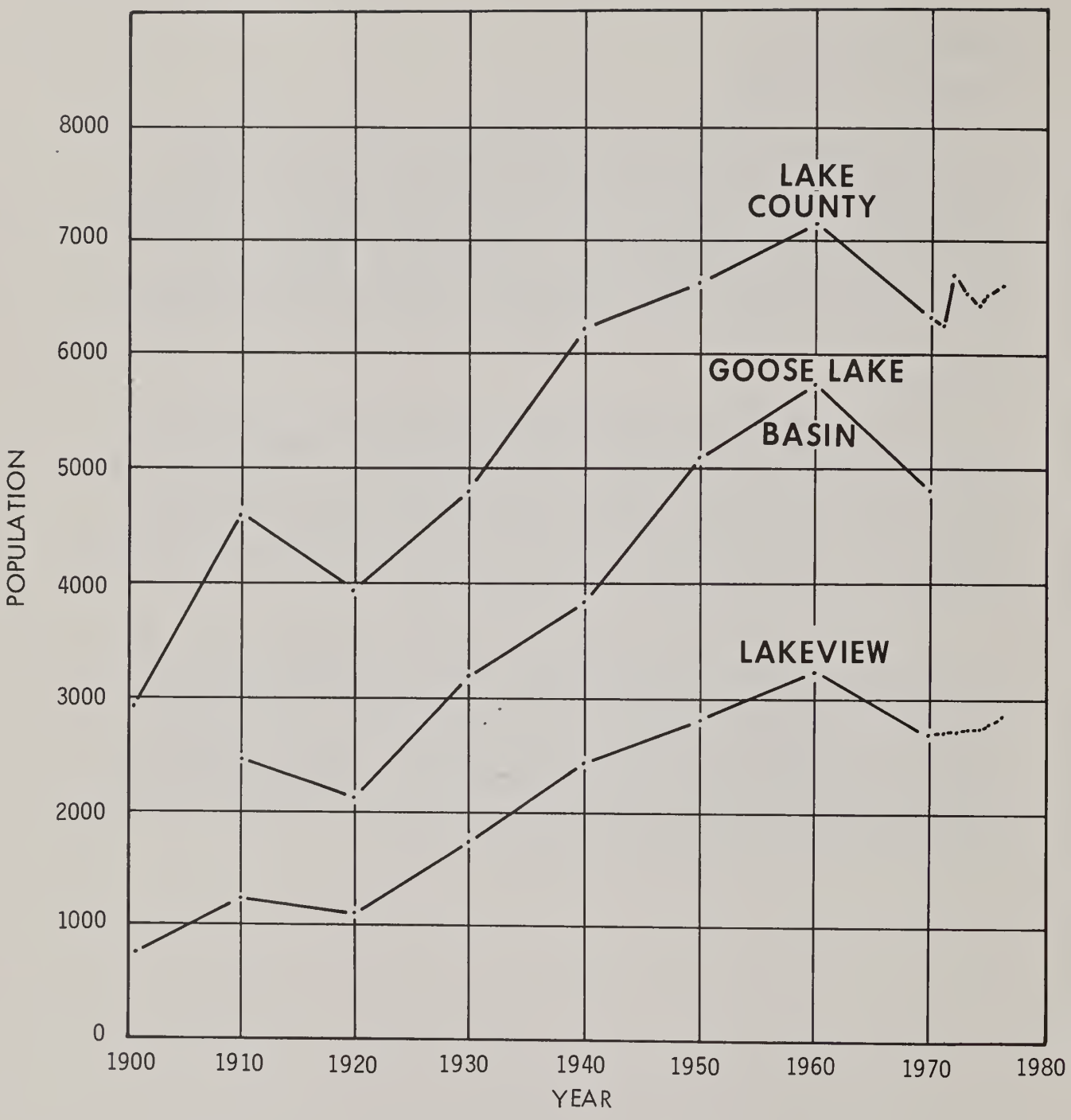
The 1970 Population of Goose Lake Drainage Basin was about 4,830 persons (figure 6).[1/] Population density for Goose Lake Basin was about 7 persons per square mile in 1970, compared to less than 1 person per square mile for Lake County, and 22 for the State. Lakeview population was 2,705 persons, a little more than one-half of the basin population. Population decreased from 1960 to 1970, from 5,751 to 4,830 persons, a 16 percent decrease. Lake County population for 1980 is projected to be from 6,418 to 6,738 persons.[2/]

Population by age group (table 19) shows that while overall Lake County population decreased from 1960 to 1970, both the number and percentage of retirement-age persons has increased. The retirement age group increased from 562 in 1960 to 609 in 1970, an increase of from 8 to 11 percent of total county population. The 15-64 age groups decreased over the same peirod by 337 persons. This is generally indicative of outmigration of the productive, working age groups, partly due to lack of satisfactory job opportunities.

1/ Population of the Goose Lake Drianage Basin was estimated from publications of the U.S. Bureau of the Census, U.S. Census of Population, Oregon; and from Population Estimates: Oregon Counties and Incorporated Cities, Center for Population Research and Census, Portland State University, Portland, Oregon

2/ Farness, Donald H., et. al. An Economic Analysis of Resource Allocation in the Oregon State Highway Division, Departmtne of Economics, Oregon State University, October 1972, p. 18a.

FIGURE 6 --Population



SOURCE: U.S. Bureau of the Census and Center for Population Research and Census, Portland State University, Oregon

Table 19.--Population by age groups, Lake County, Oregon 1960 and 1970

Age group	Year 1960		1970	
	Number	Percent	Number	Percent
14 years & under.....	2,322	32	1,797	27
15-19.....	495	7	655	10
20-64.....	3,779	53	3,282	52
65 years & over.....	562	8	609	11
Total	7,158	100	6,343	100

SOURCE: U.S. Bureau of the Census, Census of Population: 1960 and 1970, General Population Characteristics, Oregon.

Employment

Average annual Lake County employment for 1976 was 2,580 persons.[1/] For the Goose Lake Drainage Basin, including Lakeview, 1976 employment was about 1,930 persons.[2/] County employment for 1980 is projected at above 2,800 persons.[3/]

Average annual unemployment since 1970 ranged between a low of 7.6 percent in 1973 to a high of 12.2 percent in 1975. Unemployment is highly seasonal, sometimes as high as 15 and 16 percent during the months of February, March and April, and as low as 4 percent in August and September.[4/] Variable monthly employment is likely due to the seasonal nature of the basic industries, forestry and agriculture.

Income

The mean family income of Lake County in 1970 was $9,068, compared to $10,965 for the state (Table 20).[5/] Per capita incomes were $2,628 and $3,163 for Lake County and the state, respectively.

1/ Oregon Resident Labor Force, Unemployment and Employment, 1976, Research and Statistics Section, Employment Division, Oregon Department of Human Resources, revised March, 1977.
2/ Estimate is based on 1970 population-employment ratio of 0.4 for Lake County.
3/ Op. Cit., Farness, p. 16a.
4/ Op. Cit., Oregon Resident Labor Force.
5/ U.S. Bureau of the Census, Census of Population: 1970, General Social and Economic Characteristics, Oregon.

Table 20.--Income comparisons, Lake County, Oregon, 1970

Area	Mean family income	Mean family income as a percent of Oregon	Per capita income
	Dollars	Percent	Dollars
Lake County	9,068	85	2,628
Klamath County	9,622	90	2,912
Harney County	9,680	91	2,856
Oregon	10,695	100	3,163

SOURCE: U.S. Bureau of the Census, Census of Population: 1970, General Social and Economic Characteristics, Oregon

Of all counties in the state, only 5 had a larger percentage of families below the poverty level in 1970 than Lake County. The percentage of families below the poverty level in Lake County was 12.4 percent, compared to 8.6 percent for the state. However, Lakeview had only 5.6 percent of families below the poverty level.[1/]

Transportation

Goose Lake Drainage Basin is relatively isolated from major population centers and marketing areas. Lakeview is 339 miles from Portland; 324 miles from Boise, Idaho; 212 miles from Winnemucca, Nevada; and 95 miles from Klamath Falls, the nearest city with a population of over 15,000 persons.

Major highways include State 140, an east-west route connecting Lakeview with Klamath Falls, and U.S. 395, a north-south route providing access to Burns and Bend (via State 31), with California to the south. Numerous other improved and unimproved roads service the local area.

A branch of the Southern Pacific Railroad connects Lakeview with Alturas, California, providing a means of marketing lumber from the Lakeview mills. An airport flying service provides charters and emergency services to the local area.

1/ U.S. Bureau of the Census, Census of Agriculture, 1969, Vol. 1, Area Reports, Page 47, Oregon

AGRICULTURAL INDUSTRY

Number and Size of Farms and Ranches

In 1974 there were 282 farms and ranches in Lake County.[1] The average size of farms and ranches in 1974 was 3,235 acres, compared to 3,152 acres in 1969. For the State of Oregon the average size of farms in 1974 was 682 acres.

Types of Farms and Ranches

Livestock ranching is the predominant type of agriculture in Goose Lake Drainage Basin. Of 464,270 acres in the Basin, 118,280 acres (25 percent) are rangeland and 48,270 acres are classified as pasture. Another 44,390 acres (10 percent) are cropland largely used to grow hay to support the livestock industry. The remaining Goose Lake Drainage Basin area is composed of 211,180 acres of forest lands and 42,150 acres of "other lands" --roads, farmsteads, urban areas, etc.[2]

While statistics are not readily available for Goose Lake Drainage Basin, the 1974 Census of Agriculture reports that 65 percent of all farms in Lake County are full-owner operated.[3] Another 27 percent were operated by owners who also rented additional acreages. Only 8 percent of the farms were entirely tenant operated. Over 77 percent of farms in Lake County were classified as individual or family-type farms.

Agricultural Investment

Average investment per farm or ranch unit in 1974 was $403,484 for Lake County.[4] This compares to $183,526 in 1969. The average per acre investment was $125 and $58 for 1974 and 1969 respectively, a 116 percent increase over the fiveyear period.

Value of sales, employment, and income

Agricultural production in Goose Lake Basin is primarily livestock oriented. Of the total 1975 county value of sales $10,977,000 for all agricultural products $8,620,000 (70 percent) was the value of livestock and livestock products.[5] Ninety-seven percent of the value of livestock and livestock products sold is attributed to the sale of cattle and calves.

1/ U.S. Bureau of the Census, Census of Agriculture, 1969, Vol. 1, Area Reports, Page 47, Oregon
2/ Acreages were obtained by LANDSAT satellite telemetry, as discussed earlier.
3/ Op. Cit., Census of Agriculture
4/ Ibid.
5/ Commodity Data Sheets, compiled by the Extension Economic Information Office, Oregon State University, Corvallis 1977.

Major crops grown in the area include hay, wheat, barley and other small grains. Much of the hay and feed grain crops are utilized locally in support of the livestock industry.

The major livestock enterprize in the basin is the cow-calf operation. Sheep numbers have declined from 41,000 in 1950 to less than 1,000 in 1976.

Sales of crop and livestock products in Lake County exceeded 13.8 million dollars in 1977 (table 21).[1/] Sales for the Goose Lake Drainage Basin are not available but would be a significant portion of the Lake County total. The sales of cattle and calves made up about 70 to 87 percent of the total 1972 through 1977 total value of agricultural sales.

The value of sales of "other" crops has increased eight-fold since 1972. Increased sales of "other" crops is attributed primarily to expanding production and sales of mint crops, and increased farm timber harvest sales.

Agricultural employment for Lake County in 1974 consisted of 963 workers, according to the U.S. Census of Agriculture.[2/] Only 215 persons worked 150 or more days in 1974. About 40 percent, or 387 persons, worked less than 25 days. The number of farm workers working for 25 to 149 days was 361 persons.

Agricultural income for Lake County is estimated from data in the 1974 U.S. Census of Agriculture. In 1974 the market value of commercial[3/] farm sales was $12,810,000, as reported in the census.

1/Ibid., 1978
2/Op. Cit., Census of Agriculture
3/Farms with sale os $2,500 and over

Table 21 .--Sales of agricultural products, Lake County, Oregon 1972-77

Item	Year					
	1972	1973	1974	1975	1976	1977p
	- - - - - - - - Thousand dollars- - - - - - - - -					
Wheat.....	86	327	572	538	446p	NA
Barley.....	89	141	278	344	161p	NA
Other grains[1]	49	60	104	77	96	523
Hay.....	744	946	1,240	1,191	1,471	1,708
Other crops[2]	111	169	63	207	953	955
All Crops.....1,079		1,643	2,257	2,357	3,127	3,186
Cattle and calves	8,243	12,392	7,032	8,370	7,731	10,426
Dairy products	16	18	31	57	58	86
Hogs.....	24	27	108	50	30p	NA
Sheep and lambs.....	25	80	78	47	25p	NA
Other livestock 3	52	45	63	96	81	183
All livestock and livestock products	8,360	12,562	7,312	8,620	7,925	10,695
Total- all crop & livestock products	9,439	14,205	9,569	10,977	11,052	13,881

p= Preliminary.

NA = Not available

1/ Includes feed grains, oats, and other miscellaneous grains.

2/ Includes field crops such as mint and seeds; and specialty products such as nursery stock, greenhouse items, and farm forestry products.

3/ Includes chickens, eggs, and other miscellaneous livestock and livestock products.

SOURCE: Extension Economic Information Office, Oregon State University, Corvallis, Oregon.

TIMBER INDUSTRY[1/]

Settlement of the Lake County area began around 1869. Population growth and industrial development were slow due to a lack of efficient transportation facilities and distances to major markets.

The first sawmill, which supplied lumber for local use, was erected in the mid1870's as an addition to a grist mill. By 1889, five sawmills produced 1.25 million board feet of lumber with a $20,000 taxable value. In 1925, six mills in the county were producing 5.35 million board feet of lumber (figure 7).

The year 1933 marked the beginning of rapid growth in lumber production, with eleven mills producing 49.1 million board feet of lumber. By 1935, ten sawmills had increased production to 65 million board feet. Growth in the industry continued at a generally uniform trend. By 1974, four sawmills produced 113 million board feet. This, while the number of mills has decreased in recent years, total productivity increased due to mill expansion and technological improvements.

Today, there are four sawmills with a capacity of 140 million board feet per year, and one veneer mill with an annual capacity of 144 million square feet (1/8 inch basic) per year. All of the mills are in Lakeview, so the county lumber production is also the basin's lumber production. Sawlogs, however, come from all of the county forest lands.

Timber harvest in Lake County has ranged between 172 and 396 million board feet from 1965 through 1975 (figure 8). The 1974 harvest was 311 million board feet, with 42 percent from National forest lands, 44 percent from private industry lands and 14 percent from other private lands.

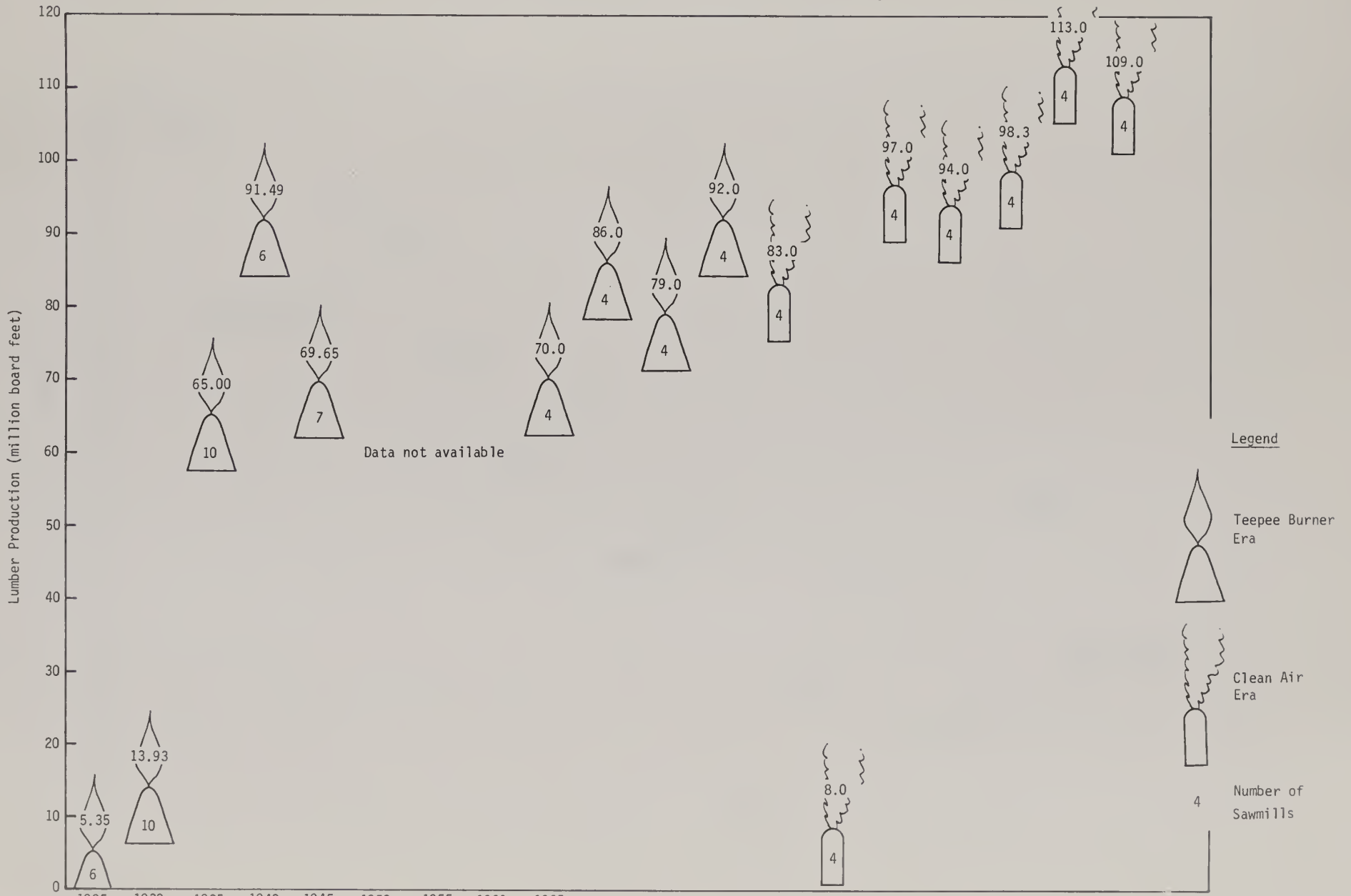
Lake County began as an importer of sawlogs. It was not until the early 1930's that log production exceeded mill sawlogs. The county has been an exporter of sawlogs since at least 1965, with most of the logs going to Klamath County and the balance to Deschutes County. County mills only utilized 29 percent of county logs from 1965 through 1975.

From 1965 through 1975, 46 percent of the timber cut in Lake County came from National forest lands (figure 9). Another 46 percent originated on private timber industry lands, while 8 percent came from other private lands. Timber cuts from Bureau of Land Management stands and from state lands have generally been less than 0.1 percent of the total harvest.

1/ Information in this section was provided by the Forest Service, U.S. Department of Agriculture, Portland, Oregon 1978.

FIGURE 7

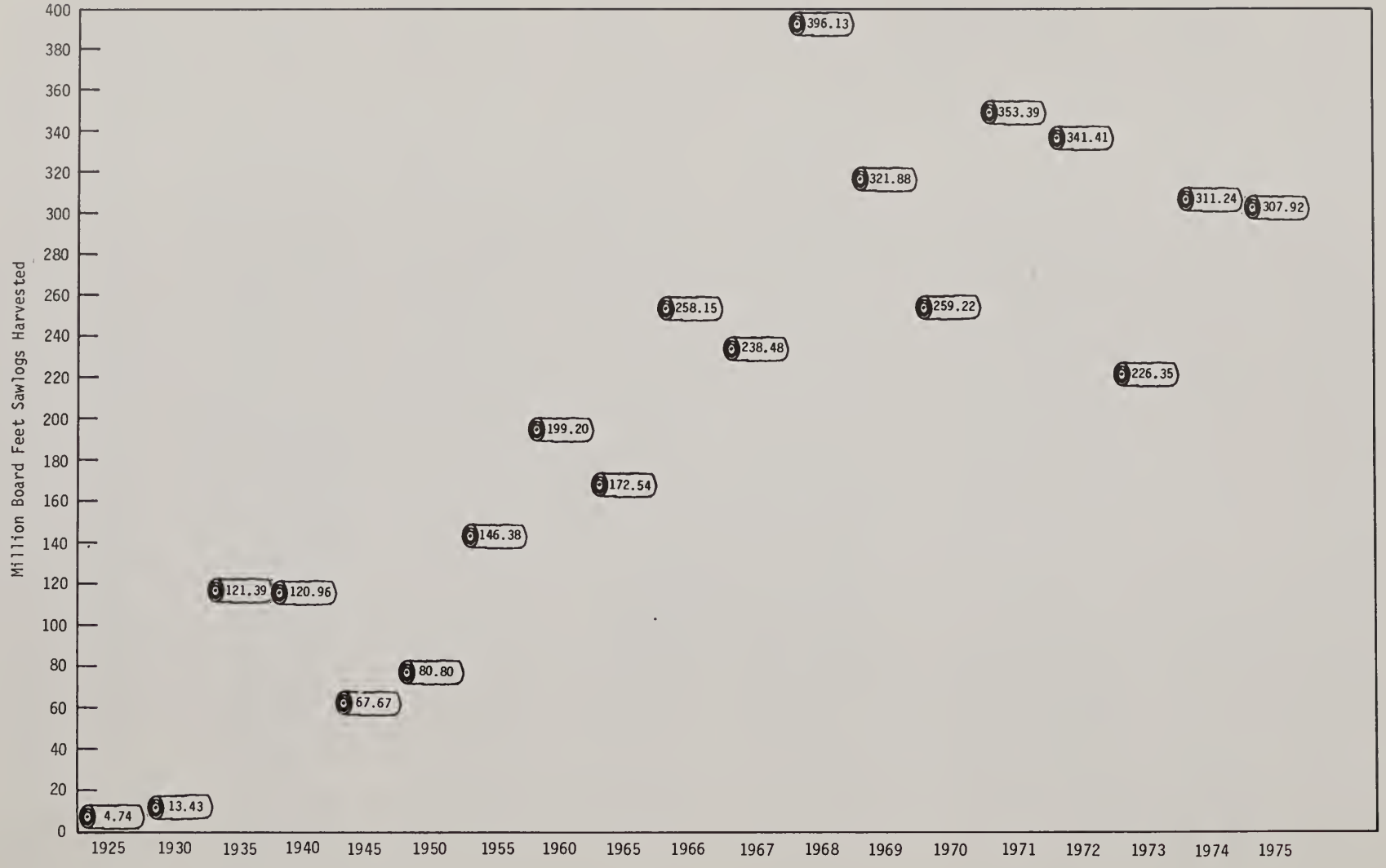
Number of Sawmills and Lumber Production, Lake County, Oregon



Source: Pacific Northwest Experiment Station, USFS and Western Woods Products Association.

FIGURE 8

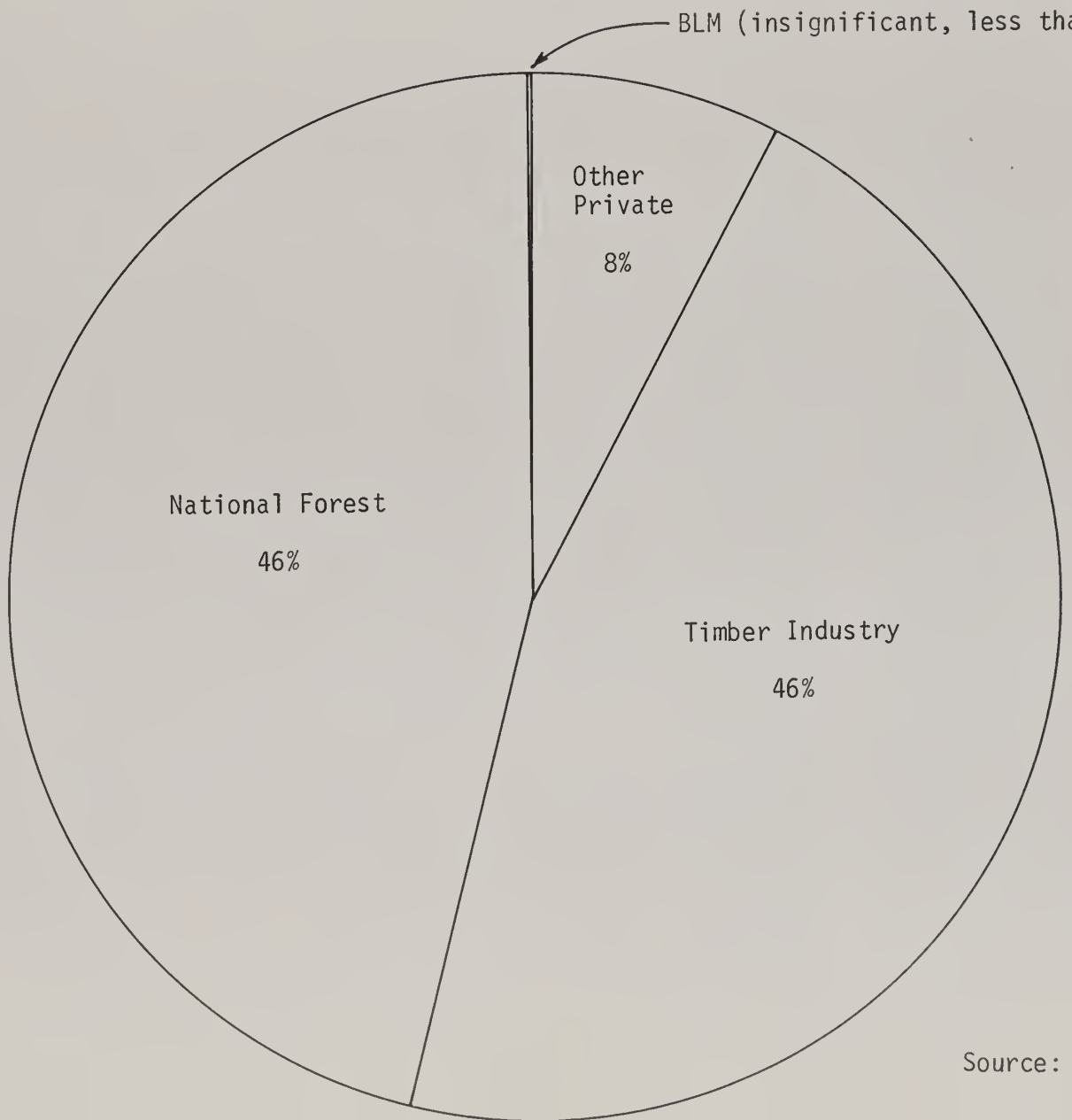
Timber Harvest, Lake County, Oregon



Source: Pacific Northwest Experiment Station, USFS.

FIGURE 9

Timber Cut (Percent of Total) By Ownership
(1965 - 1975), Lake County, Oregon



Source: USDA Study Team

The portion of timber cut from National Forest lands assures the Lakeview area of a stable source of log supply. These lands have been established as a sustained-yield unit for this area. Primary manufacture of logs from National Forest lands within the unit is limited to Lakeview and Bly. This action was taken to stabilize the economy of the timber dependent communities in Lake County.

RECREATION

An estimate of 1969 tourist expenditures in Lake County was made by the Oregon State Highway Division.1/ Tourist expenditures totaled $5,764,353, of which 40 percent was attributed to out-of-state visitors, 49 percent from within state, and 10 percent from within county. The total tourist expenditures for Lake County were only 0.7 percent of the total State of Oregon expenditure.

Tourist-related payrolls for 1969 have been estimated at 13 percent of the total county payroll, and at 5 percent of total county personal income.2/ Outdoor recreational trips originating in Lake County totaled 47,201 in 1969, and trips destined for Lake County totaled 87,522, according to the Highway Division.3/

1/ Op. Cit., Farness, P. 24a.
2/ Ibid, p. 27a.
3/ Ibid, Appendix II-U.

WATER AND RELATED LAND RESOURCE PROBLEMS

WATER AND RELATED LAND RESOURCE PROBLEMS

INTRODUCTION

The principal problems in the Goose Lake Drainage Basin discussed in this report are: winter and spring flooding, erosion and sedimentation, impaired drainage, water shortages, water use and conservation and water quality. These problems are extremely important to consider in connection with improved management opportunities for agriculture, range, and forestry. The individual problems will be discussed for all land uses under the specific subject headings.

LAND RESOURCE PROBLEMS

Flooding

The Goose Lake Drainage Basin has a complex flooding situation. This is directly related to geomorphologic history and the closed basin nature of the area. Goose Lake, 50 percent of which lies in California, is the Basin's dominant water storage area. Seasonal water level fluctuations are caused by surface and subsurface flows in the Basin. These flows are influenced by the volume and intensity of rainstorms and springtime snowmelt in the mountains. Major flooding occurs with a combination of these events. In early spring, rain and low elevation snowpack melt combine to cause an elevation increase in the Goose Lake detention pool. This elevated water level causes local shoreline flooding and saturated soil moisture content. Many thousands of acres of valley aquifer are affected. Upper elevation snowpack melt is usually synonymous with this fully charged valley condition. Runoff occurs resulting in scouring of some channels and flooding of the already subirrigated agricultural valley lands. The water table is often slow to drop, causing reduction in forage crops and limits machinery access to fields.

Any program having the objective to reduce flooding of the valley and its aquifers must be coordinated with the State of California, since more than 50 percent of the catchment area to Goose Lake is located in that State.

The damage associated with flooding in this Basin is limited to pasture inundation. The loss of life and physical property is rare due to the low population density and wide floodplains. Soil conditions, climate, and short growing seasons are the primary reasons why crops are limited to pasture and hay production as opposed to row crops.

Flood damage costs were estimated for the 1964 flood. These costs are shown on table 22 and are an example of typical flood damages.

Table 22.--Flood Damage, Goose Lake Drainage Basin, Oregon 1964

	Treatment measure	Cost
		Dollars
1.	Removal of debris other than sand gravel or silt	$6,700
2.	Shaping and grading or filling including removal of sand, gravel or silt	37,350
3.	Restoring dikes and levees	30,600
4.	Restoring stream channels, including riprap and revetment	35,150
5.	Restoring open or underground drainage systems	6,300
6.	Restoring dams, pits, or ponds	8,400
7.	Restoring irrigation ditches, and other irrigation installations of a permanent nature	27,510
8.	Re-seeding	11,500
9.	Restoring fences	12,050
	Total	175,560

Erosion and Sediment Damages

Introduction

A hydrologic analysis and resource problem inventory was conducted in the Basin during the field season of 1977.

A report of hydrologic analysis has been prepared and forms the basis for much of the data in this and subsequent sections with reference to problems and alternatives. This report is available as a reference for this study.

Erosion and sediment problems are discussed under six general headings. These are stream channel, streambank, abandoned mines, reservoir shoreline, roads and utility corridors, and other areas. (General Erosion Sources map).

Stream Channel Erosion

The forested land in the basin contains 108 miles of perennial stream as measured from USGS quad sheet maps. This primary distribution system for the water resource is in varying stability condition classes due to natural and maninduced activities. There is a direct correlation between stream channel stability and stream erosion, and the resulting fluvial sedimentation which has a delivery ratio approaching 1.0.

Channel erosion also depends on the magnitude of stream flow and peak discharge impact period. In this study area the higher channel erosion rates are derived from depositional land forms such as valley bottoms and old lake beds where banks contain fine textured soils, low density root holding vegetation, and sparse rock content. Stream channel erosion in these areas has often been accelerated by cattle trampling during watering.

Table 23.--Channel stability of forested streams, Goose Lake Drainage Basin, Oregon

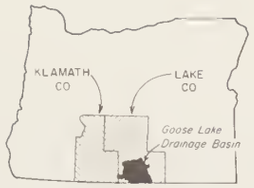
Channel stability class 1/	Length	Mean Erosion	Gross erosion	Gross sediment
	Miles	Tons per mile per year	Tons/Year	Tons/Year*
Excellent	10.8	10	108	102.6
Good	21.6	20	432	410.4
Fair	48.6	50	2,430	2,308.5
Poor	27.0	100	2,700	2,565.0
Total	108.0	- -	5,670	5,386.5

*Assumed an average .95 sediment delivery ratio. The percent of stream erosion which appears in the stream system as fluvial sediment.

1/ Streamside management units located on USFS Lakeview Ranger District. Stream stability classification estimates derived using U-2 color infrared photography and the USFS stream channel stability evaluation system 1975 R-1-75-002.

GENERAL EROSION SOURCES
GOOSE LAKE DRAINAGE BASIN
OREGON

DECEMBER 1977



LOCATION MAP

LEGEND

- Rockland
- Talus
- Sparse Forest
- Forest Lond
- Severe Stream Bank Erasion
- Forested Land Boundary
- Basin Boundary
- Mine
- Slide

Source:
Base map prepared by SCS, WTSC Carto Staff from USGS 1:24,000 quads.
Thematic detail compiled by USFS from interpretation of false color infrared aerial photographs taken in June 1975.

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA SCS-PORTLAND OR 1978

M7-SN-23835-6

Streambank Erosion

Streambank erosion is a primary cause of fluvial sedimentation in the Basin. Much of the low erosion rate areas are from natural sources. Generally the forest land streams contain rock and deep-rooted riparian vegetation such as trees, brush, and grass which have developed over time and adequately prevent accelerated erosion except during flood runoff events. An exception is the gullies frequently found in the fine textured meadow soils.

Most of the accelerated streambank erosion is associated with man's activities such as mining, grazing, road construction, reservoir construction and associated water release, and logging debris in stream channels.

The Basin contains approximately 214 acres of severe bank erosion in need of stabilization. This erosion source has a sediment delivery of 95 percent, and contributes about 1,232 tons of fluvial sediment per year.

Abandoned Mines

Two abandoned uranium mines exist on the forest lands in the Basin. These mines were closed in 1965 but not rehabilitated. The following is a summary of area rehabilitation need.

Table 24.--Abandoned uranium mine tailings, Goose Lake Drainage Basin, Oregon

Mine	Tailings	Tailings	Gross
	Area-Acres	Pond-Acres	Acres
Lucky Lass	23	5	28
White King	120	15	135
Total Acres	143	20	163

The forecast of a scarcity of uranium for planned nuclear electric generating plants through the year 2000 has already encouraged mining companies to re-evaluate the resource potential in the Lakeview area.

Reservoirs

The existing irrigation reservoirs are a primary source of suspended sidement nonpoint pollution in the Basin. This is because the reservoirs are constructed on remnant geologic lakebeds containing fine textured soils. These sites were cleared and grubbed during reservoir construction and now contain steep unvegetated sections of shoreline. The wind and wave action on the fine textured shoreline soils turn the detention waters highly turbid. These sediments are colloidal with very low settling rates which muddy streams and canals for several miles downstream.

The conditions of water in existing reservoirs is displayed on table 25.

Table 25.--Water conditions of reservoirs, Goose Lake Drainage Basin, Oregon 1977

Reservoir/Lake	Turbidity	Area
		Acres
Renner Reservoir	Muddy	350
Drews Reservoir	Muddy	4,971
Cottonwood Reservoir	Muddy	452
Butcher Flat Reservoir	Muddy	120
Cottonwood Lake	Clear	41
South Arm Reservoir	Clear	92
Dog Lake	Clear	241
Total		6,267

Roads and Utility Corridors

One of the most noticeable sources of erosion and sediment are from forest roads. Particularly, those sections encroaching on or adjoining stream channels. The gross miles of utility and transportation corridors amount to 4,069 miles which translates into 9.21 miles per square mile of forest land watershed. (Table 26).

Table 26.--Forest roads, Goose Lake Drainage Basin, Oregon 1977

Erosion source	Total mileage	Erosion width	Erosion area
	Miles	Feet	Acres
All-weather, 2 track	140.0	20'	169.79
Dirt, 2-track	237.0	20'	574.55
Primitive, 1-track	692.0	10'	838.79
Jeep trail	2.0	10'	2.42
Skid roads, ½ track	3000.0	10'	3,636.36
Powerline right-of-way	25.0	100'	309.09
Total	4,096.0		5,531.00

Impaired Drainage

Approximately 34,000 acres of the land in the Basin has a major wetness problem. The elimination of prolonged flooding is frequently a requirement for effective drainage. Drainage can be classified as surface flooding needing land treatment or flood control measures in some areas. Irrigation has resulted in raising the water table within the rooting zone of some naturally well or even excessively well drained sites.

Some of the wet soils have been drained to a degree necessary for the crop being grown and some are used for purposes that do not require drainage. Poor quality pastures are frequently developed on improperly drained soils.

Insects and Disease

There are three insects which have posed a threat to the timber resources of the Basin in the last 5 years. These are the Modoc budworm, western pine beetle and mountain pine beetle.

The Modoc budworm continues to cause light defoliation in white fir stands along the Warner Mountains. Populations of the insect have been in a decline and are not currently considered serious. The population will continue to be monitored.

The western pine beetle has caused moderate losses in mature ponderosa pine trees in the southwest portion of the Basin. Populations of the insect have been on the increase and bear close observation. A rapid buildup of this insect could be triggered by favorable climatic conditions.

Mountain pine beetle has devastated much of the lodgepole pine in eastern Oregon. Lodgepole pine is a minor species in the Basin and the impact of the insect has not been as critical there as in other parts of the State. A potential still exists for the insect to be a problem, and a surveillance must be maintained for any change in its activities.

Timber stands in the Basin have a high percentage of mature to overmature trees. These trees are highly susceptible to insect attacks. Timber land managers must be alert to the potential dangers of insect attack until this inventory of older trees is reduced by timber harvest. There will always be a threat of insect attack regardless of age. Overmature trees are just more susceptible.

Noxious Weeds

Canada thistle is a common noxious weed and a major problem throughout the watershed. Other noxious and poisonous plants are only minor problems except in local areas within the watershed. Orange sneezeweed is a minor problem on the National Forest as a poisonous plant. At low elevations within the Juniper and Shrub zones, two weeds, Mediterranean sage (a biennial weed) and Medusa-head wildrye (an annual grass) are invading road sides, depleted rangeland and even some rangeland in better condition.

Forest and Range Fire

Fire has not been a significant problem in recent years in the Goose Lake Basin. Large fires have occurred in the past and potentially could occur again. Presuppression and suppression activities during the last five years have held the few fires which have occurred to a minimum of acres burned. (Table 27)

The Lakeview District of the Fremont National Forest was responsible for all fire presuppression and suppression activities until 1976. A Fire Protection District has been formed to cover private forest and rangelands which lie outside the Lakeview District boundary.

Table 27 Forest and range fires, Goose Lake Drainage Basin, Oregon

Fire Source	1973	1974	1975	1976	1977
			Number		
Lightning-caused	24	34	40	33	61
Man-caused	17	7	7	3	4
Total no. of fires	41	41	47	36	65
			Number		
Total acres burned	120	15	10	5	330

Source: Lakeview District, USFS, State Forester Report

Forage Shortages

Ranchers without rangelands in the valley floor or foothills lack spring range and have long feeding periods of 5 months or more. The long feeding period is an economic hardship. It increases the cost of maintaining a cow considerably, and it increases the risk of disease or sickness while in confinement.

The limited amount of high quality late summer range doesn't provide enough feed for the demand available.

The poor condition of some of the more accessible and heavily used rangeland has greatly reduced its forage value. Forage production in these places is much lower than in the original stands which were dominated by palatable perennial bunchgrasses. The amount of poor condition range is unknown but probably amounts to a large proportion of the uncultivated (native range) areas representing juniper, shrub, or grassland plant communities.

There has been a lack of coordination of private land development with winter range forage supplies for mule deer. Areas of

deer winter range in the Shrub Grassland and Juniper-Shrub zones have been converted to farmland which were formerly providing browse and cover for deer. This has reduced the acreage available for wintering deer, increased the concentration on remaining lands in the winter range, and increase wildlife use of agriculture crops.

WATER RESOURCE PROBLEMS

Water Shortages

Agricultural Crops

There are 38,820 acres irrigated in the Basin. About two-thirds is in the immediate area of Lakeview and Goose Lake. The state considers 2.5 acre feet to be the minimum grass irrigation water requirement for most of the area. This would indicate a need for 97,050 acre-feet of water. However, the mean annual yield for the three main streams of the Basin, Drews, Cottonwood, and Thomas Creek, was only 66,900 acre-feet for the period 1910-1935. There are two main reservoirs serving the area; Drews Reservoir, capacity 62,500 acre-feet; and Cottonwood Reservoir, capacity about 8,700 acre-feet. This indicates large acreages short of water each year.

The cropping pattern on irrigated land is about 16 percent alfalfa, 43 percent grass hay and pasture, and 41 percent spring grain. The weighted net irrigation requirement is 1.24 feet per acre. Net irrigation was determined by the modified Blaney Criddle method. Present overall irrigation efficiency is considered to be about 33 percent. At this efficiency 145,480 acre-feet would be needed for full season irrigation. This amount could be reduced significantly with improved efficiency. If overall efficiency were improved to 59 percent it would reduce full season requirements to 81,590 acre feet. This tends to indicate that there is not sufficient yield in the basin to adequately irrigate all the land under irrigation.

Livestock and Rural Domestic

Livestock water distribution is not a major problem in all areas of the Basin, but could be improved at several locations, especially late season water supplies. This is especially true of summer range in the southwest portion of the basin. Most ranchers had water to enable them to utilize private rangeland properly.

Most of the rural domestic water is obtained from wells. Wells along the east side of Goose Lake Valley are generally inadequate as to quantity, they are generally shallow wells. The wells along the west side of the valley generally are adequate in quantity but very poor quality.

Non Agricultural

Lakeview's water supply is inadequate to meet future growth needs. Their present source is from several wells, none of which have sufficient quantity, even when combined they are inadequate.

Recreation Problems

Hunting and fishing are the principal outdoor recreational activities in the Basin. Both are indirectly dependent upon the water resources. Over ninety-five percent of the water rights in the Basin are for irrigation and other uses. Recreational opportunities, besides satisfying a social need, enhance the local economy by attracting visitors from outside the basin.

Expanding populations in Oregon and California will tend to cause greater use of the basin's recreational resources. Earnings from recreation will probably grow in significance, thereby helping to diversify the basins's economy.

Conservation of existing fish and wildlife resources is essential to the maintenance of the recreational potential.

Many of the reservoirs and lakes such as Dog Lake have dense vegetation (phreatophytes) along the shallow water shorelines. These plants make access and use of the shoreline difficult. An even more critical problem are the swarms of mosquitos which breed in these plant-infested shallows. Many of the campgrounds and water areas are avoided by recreationists because of this problem.

Suspended sediment loads in many of the reservoirs, such as Drews reservoir, reduce the use and recreation value of much of the surface water of the Basin. Such activities as swimming and water skiing are extremely limited, partly by lack of developed facilities and also because of the sediment loads in most existing water bodies large enough for these activities.

Wildlife and Fish Problems

Wildlife

The basin is rich in wildlife chiefly because of its low level of development. Species include deer, upland game, and waterfowl. Mule deer inhabit the timbered mountain slopes during the summer, and winter at lower elevations. Deer populations have benefited from habitat improvement measures.

Several kinds of upland game birds, including pheasant, partridge, grouse, and quail inhabit the basin but they are not numerous. Severe winters, drought, disease, predation, and insufficient food and cover are some of the limiting factors relative to these species. Habitat improvement has furnished some relief from these problems.

The basin is a natural resting and wintering area for ducks, geese, swans, and other migratory waterfowl using the Pacific flyway. In it may be found nearly every waterfowl species known in the Western United States. Some adverse affects on the resource have been caused by reclamation of marshland, resulting in the reduction of habitat.

Water problems affecting wildlife are those common to other uses, particularly inadequate supplies in critical water years.

Fish

Rainbow trout is the most important fish species and is found in nearly all of the perennial streams and lakes. Some streams are stocked annually with legal-size trout to help increase the anglers' success. Considerable effort has been expended in recent years toward fish habitat improvement. Measures include the construction of Cottonwood Meadows Reservoir for propagation of fish life and elimination of scrap fish from Drews Reservoir, followed by stocking with rainbow fingerlings.

Inadequate summer streamflows, particularly in low water years, is the principal problem in maintaining the fishery resource. Alkaline waters of Goose Lake presents a quality problem. Increasing consumptive use of water could intensify current problems. The principal habitat remaining for the establishment and maintenance of a fishery resource is in the high lakes, reservoirs, and headwaters of streams.

PRESENT AND FUTURE NEEDS FOR WATER AND RELATED LAND RESOURCE DEVELOPMENT

PRESENT AND FUTURE NEEDS FOR WATER AND RELATED LAND RESOURCES DEVELOPMENT

INTRODUCTION

Coordinated planning and development of the water and related land resources of the Goose Lake Drainage Basin is greatly needed. The Basin probably has adequate water to develop the potential and meet the future needs of the land and industry if utilized and managed properly. This would require a study and development of the ground water potential, construction of storage facilities, improved distribution and irrigation systems and coordinated use of the water resource.

LAND DEVELOPMENT NEEDS

Watershed Protection and Management

Soils of the upper watershed (forest resource zone) are all well drained with a medium to high water holding capacity. These soils are effective water producers, occupying the highest precipitation areas of the Basin. The soils are highly responsive to vegetative manipulation to produce increased water yield. Care must be exercised to avoid programs which leave the soil bare in significant acreages. The erosion hazard varies from moderate to severe. Any vegetative manipulation, whether for resource use such as timber harvest or for water production, must give first consideration to maintaining stability of the basic soils resource.

Soils of the middle watershed (range resource zone) are also generally well drained with low to medium water holding capacity. These soils are not as deep as the forest soils which occupy lower precipitation areas. These soils would be moderately responsive to increased water yield through such practices as snow fence construction. Such activity would rob moisture from a resource (range) which already suffers from water shortages. The soils have a moderate to severe erosion hazard also. Any vegetative manipulation to increase water supply should have the objective of retention and redistribution through water spreading practices on the rangelands.

Soils of the lower watershed (croplands) are poorly to moderately drained, deep, with medium to high water holding capacities. These soils have a slow permeability with a high moisture retention rating. Hardpans are often underlying these soils, resulting in wet, alkaline soils. These soils receive much of the runoff of the upper and middle watershed areas, accompanied with much flooding. The soils have a low to moderate erosion hazard, due mostly to the flat slopes.

Flood Protection and Land Stabilization Needs

Significant flooding occurred in past years along Thomas Creek with damages being primarily the loss of agricultural production.

Flood-control measures such as dikes and dams should be considered to provide protection to these flooded lands.

Eroded stream banks should be shaped and vegetated, and an attempt should be made to shape and revegetate gully and sheet-eroded lands. Local small-scale structural measures and land treatment are needed to reduce erosion caused by man's activities in the Basin. Land treatment should be applied whenever possible to stabilize areas of accelerated erosion.

Revetment works or establishment of vegetation is needed to protect streams in the Basin. Larger channels where flows are generally deep and swift probably will need revetment works and the smaller upstream channels probably could be protected by suitable vegetative cover.

These land stabilization works would reduce sediment yield. Fish habitat and spawning areas would be improved; less sediment would accumulate in reservoirs; and the streams and rivers during stormy periods would not be as muddy. Because roads and other facilities would incur less damage, much of the inconveniences to traffic could be avoided.

One of the priority needs in the Basin is implementation of a floodplain zoning program.

Drainage Improvement

Drainage improvement is needed where agricultural land lies in broad, flat valleys with relatively impermeable soils or in closed drainage basins. These improvements include: improved surface drainage to permit farming operations earlier in the season; open drain ditches and tile drains to lower the water table; improved outlets; and construction of sumps and pumping plants.

In the Basin, some of the poorly to very poorly drained soils need pumping to lower the water table. The somewhat poorly to poorly drained soils of the Basin should, in general, be drained and improved by using ditches or closed drains. The moderately well to somewhat poorly drained soils should, in general, be improved by using either ditches or closed drains with a comparatively wide spacing. Some soils in the Basin received runoff water in the spring which accumulates as shallow intermittent ponds or sheets of water on the surface. Such areas need to be protected by diverting runoff water into channels or ditches before it reaches the pond areas.

Forest and Range Needs

Forest and range lands make up 71 percent of Goose Lake Drainage Basin. A large percentage of the economy of the Basin is dependent upon the resources of these lands. Demands by the public for the many uses and products of these resources have increased at a near

frantic pace in recent years. These demands have become so competitive that continued uncoordinated use of the land and water at the present rate will result in further deterioration of these basic resources.

Federal land which accounts for 39 percent of the forest and range lands in the Basin are managed under the multiple uses-sustained yield concepts. Management of private lands varies from the shirtpocket-type plan to very detailed single-purpose plans. Some single-purpose plans allow for other uses but not, as a rule, on an equal basis as the primary purpose for which the land was acquired.

Many agencies and organizations have made resource inventories, and some have determined present demand for resources. Various projections have been made of future needs, and plans developed from these inventories, demands, and projected needs. These plans have never been combined into a single detailed resource inventory plan. Development of such a plan would set goals and give direction to all land managers responsible for resource development and use. Only in this way can the resources of forest and range lands become fully productive.

Many resource plans have failed because the planner was considering only the land for which he was responsible. Development of a resource based upon the plan may result in a shift of demand from undeveloped land to the developed land. The impact of actual use on the developed land may be greater than that planned. Over-use can result in deterioration of the resource base. The reverse situation--under utilization--may also occur where developments are duplicated by two different land managers for the same demand.

The present situation is of immediate concern. In spite of the existence of the sustained-yield unit, the annual cut of timber in the Basin exceeds the annual-growth rate by an estimated 32 million board feet. Factors contributing to this are: large acreages of over-mature timber which show a net loss in volume due to mortality losses; the unstocked acreage; and the overstocked acreage which is growing at about 40 percent of potential. The cut is presently coming from the old-growth inventory. Once this old growth is gone, the cut must come from the managed second growth. The volume cut per acre at each entry period will be less because of tree size, but the rotation or age of the tree at harvest will be 80 to 120 years, instead of the present 300 plus years. The potential for net growth will be greater after the old growth is cut.

There are 5,100 acres of dense ponderosa pine stands which need non-commercial thinning. Reforestation is needed on about 7,500 acres. Brush is a problem on most of these areas.

A first approximation estimate of critical forest land restoration needs in Goose Lake Drainage Basin to improve hydrologic conditions and water quality is displayed on table 28. Implementation of the works of improvement on priority areas will result in an estimated 30 percent reduction in accelerated erosion and 55 percent reduction in fluvial sediment.

Table 28.--Critical Area Treatment Needs and Costs, Goose Lake Drainage Basin, Oregon, 1976

Critical Treatment Needs	Units	Unit Cost	Total Cost	Sediment reduction
		dollars	dollars	Tons/Year
Tree planting	900 acres	100	$90,000	1,500
Grass seeding	1,000 acres	50	50,000	4,000
Range fertilization	500 acres	50	25,000	1,957
Streambank stabilization (riprap)	10 acres	1,000	10,000	300
Streambank stabilization (vegetation)	90 acres	520	46,800	400
Road cut slope revegetation	75 acres	600	45,000	300
Road waterbars and vegetation	800 each	50	40,000	300
Reservoir shoreline stabilization	15 acres	1,000	15,000	5,651
Road gravel surfacing	5 miles	10,000	50,000	134
Gully stabilization (meadows)	5 miles	1,000	5,000	500
Landslide stabilization	5 acres	5,000	25,000	338
Total cost (1976 base)	- -	- -	$401,800	15,380*

*55 percent of estimated mean annual gross fluvial sediemnt production.

Although $401,800 appears to be a sizable sum, it amounts to $1.42 per acre for critical area stabilization affecting water quality and/or land productivity. Many of these areas are the resulting tradeoffs from past management objectives which did not meet today's standards of environmental protection. These restoration needs cannot be accomplished overnight, however, much has already been accomplished as part of ongoing resource management programs. More important, is the emphasis placed on problem prevention by management. This is reflected in today's resource capability allocation, soil mapping, and project planning coordination with all resources.

Range Management Problems and Recommendations

The primary range management problems for the Goose Lake Drainage Basin are listed below. These problems can be dealt with through various range management practices and through better coordination between public and private ownerships.

Balance of Spring-Summer Forage Supply

Ranchers without rangelenads in the valley floor or foothills lack spring range and have long feeding periods of 5 months or more. The long feeding period is an economic hardship. It increases the cost of maintaining a cow considerably, and it increases the risk of disease or sickness while in confinement.

The limited amount of high quality late summer range doesn't provide enough feed for the demand available.

The poor condition of some of the more accessible and heavily used rangeland has greatly reduced its value for forage. Forage production in these places is much lower than in the original stands which were dominated by palatable perennial bunchgrasses. The amount of poor condition range is unknown but probably amounts to a large portion of the uncultivated (native range) areas representing juniper, shrub, or grassland plant communities.

The lack of sufficient spring and summer range forage can be met "off the range" by expansion of irrigated pasture in the valley. This potential is limited by the land avaialable and especially by the availability of additional water. This could involve the conversion of some land from other farm crops to pasture which may or may not be economical.

Forage supplies could be increased considerably "on the range" through various techniques. Productivity of fair and occassionally poor condition range can be improved over a period of years through better management. This will improve the vigor and productivity of perennial bunchgrasses as well as allow for seed production and for

an increase in the abundance of desirable species. Better management would involve the use of range management practices such as 1) planned grazing systems, 2) range readiness, 3) safe degree of use, 4) adjustment in livestock numbers and 5) improved livestock distribution through better livestock control (fencing, salting, riding, etc.).

Improving productivity of most poor condition rangeland is not feasible in a reasonably short period of time through management practices. The number of desirable perennial forage plants is too limited and the amount of competition is sometimes too great to make rapid improvement possible. In such cases range improvement is best accomplished (where soils are suitable) with range seedings of locally adapted species. This may require brush control on some sites priot to seeding. Productivity will vary with site and species seeded, but successful upland range seedings usually can be stocked at from 2-3 acres per AUM (Animal Unit Month). However, seedings on bottomland and meadows have a much higher potential and often can be stocked at 1/3 - 1 ac. per AUM.

Forest lands have a high potential for forage production because of their more favorable moisture regime than the juniper or shrub sites. Logged forest lands could be converted to forage production permanently, if desired by the land manager, or to an interim forage crop between timber harvests. Successful seedings under such conditions could produce a significant volume of forage and might be stocked at rates of 1/2 - 2 ac. per AUM, depending on the site and species used.

Without seeding, forest stands vary considerably in their forage production depending on the site, history of disturbances, and density of overstory. Management of the timber stand probably has more effect on the volume of forage produced than livestock management. The degree of overstory removal through thinning or harvesting as well as the type of ground disturbance is largely responsible for the kind and abundance of native species available. Consequently, manipulation of the stand can be used, if desired, to improve forage production.

Forestry-Grazing Conflicts

Reforestation plans affect the availability of forage in local areas. Plantations are often protected from grazing for 3-5 years which may also necessitate the restriction of grazing from a large surrounding area to provide this protection. This not only reduces the amount of forage available for grazing but can also create livestock management problems while trying to keep stock out of these plantations.

Better coordination of forest management with livestock programs is needed to reduce the hardship to the ranching industry and to make grazing more compatible with the objectives for timber production. This means that some degree of coordination of forest sale timing,

size and location, etc., within livestock pastures, and with grazing system schedules, would be desirable.

Fencing, although expensive, can sometimes be used to temporarily fence out plantations which require portection from livestock. Ranchers also need to be informed of forest management activities anticipated in their grazing units during the coming grazing season.

Agricultural Development - Conflict with Deer Winter Range

There has been a lack of coordination of private land development with winter range forage supplies for mule deer. Areas of deer winter range in the Shrub Grassland and Juniper-Shrub zones have been converted to farmland which were formerly providing browse and cover for deer. This has reduced the acreage available for wintering deer, increased the concentration on remaining lands in the winter range, and increased wildlife use of agricultural crops.

Because of economics, most land conversion from the desirable native shrub-grass range to cropland or improved pasture has been inevitable and could increase in the future, especially if water were to become available for irrigating suitable soils. Unless prime, private winter range is purchased by a public agency as a means of protecting this resource, no solution seems to be obvious and equitable to all those concerned.

Soil Erosion

Erosion problems exist in certain upland areas where vegetative cover is inadequate, but the primary problem is along raw banks of channels and gulleys. This is aggravated by excessive grazing, browsing and trampling by livestock on banks, since stock are attracted there by the presence of lush forage, easy access, or the need for water.

Solving upland water or wind erosion problems can usually be accomplished by increasing vegetative cover. Means of increasing vegetative cover were discussed above. Gully and bank erosion probably account for the greatest source of sediment and their treatment is critical. In some cases the shaping, applying riprap, and seeding of channels, possibly in conjunction with check dams, would be adequate. In other cases this is not practical, and use of a livestock management system that involves periodic deferment and/or rest from grazing and trampling is essential. In some situations, complete livestock exclusion for a period of years is the only means of stabilizing banks and re-establishing protective cover in a reasonable period of time. This approach may have the greatest adverse economic impact and is normally a practical solution only in critical situations that cannot be solved by other methods. Some exceptions exist where bottomland sites will produce more forage as a result of restoring water tables to natural levels by fencing out eroded stream corridors.

Water Distribution

Water distribution is not a major problem in every area but could be improved at many locations, especially late season water supplies. This is especially true of summer range in the wouthwest portion of the watershed.

Some existing water supplies can be improved by development. Springs developed with collection devices and storage facilities can make more water available at a given time and make it more sanitary. Water development in new areas can be accomplished, where practical, through wells, stock ponds or guzzlers, piping from existing sources, or by water hauling. Occassionally, the season of use can be adjusted for a pasture to take advantage of water available early in the season but not late.

Access

Access by livestock is a minor problem and only limiting where brush or timber is thick, or where topography is rough or steep.

Access trails where feasible can be built through brush, thickets, across steep slopes, and on or off road sides having prolonged steep cut banks or fill slopes.

Range Weeds

Canada thistle is a common noxious weed and a major problem throughout the watershed. Other noxious and poisonous plants are only minor problems except in local areas within the watershed. Orange sneezeweed is a minor problem on the National Forest as a poisonous plant. At low elevations within the Juniper and Shrub zones, two weeds, Mediterranean sage (a biennial weed) and Medusa-head wildrye (an annual grass) are invading road sides, depleted rangeland and even some rangeland in better condition.

Canada thistle can be controlled successfully by repeated spraying. Control of Mediterranean sage is possible with chemicals but quite difficult. No practical means of chemically controlling the spread of Medusa-head wildrye is available.

The best defense against the invasion of undesirable range weeds is to develop or maintain vigorous stands of perennial grasses (those characteristic of good condition rangeland) that can compete effectively with invaders.

Disturbed areas around livestock concentration areas and especially along roads where construction and/or maintenance have removed protective cover, are primary locations for the establishment and spread of weeds. A vigorous program of vegetative cover establishment and maintenance along road systems throughout the Basin could be an important deterent to the spread of noxious weeds as well as reducing erosion and sedimentation.

Predators

Predators, primarily coyotes, cause some loss to ranchers but are considered a minor problem.

Predator control will probably be adequate through methods now utilized, primarily shooting and trapping as needed by private individuals.

The Fremont National Forest is actively engaged in range development and improving management and productivity of the forage resource. About 10,000 AUMs of grazing are provided from public land within the Basin annually to 20 permittees. Future emphasis in the Forest Service programs, related to range management needs, include water development, management fences and forage seeding in conjunction with tree thinning.

Private landowners have had, and still have, access to assistance from public agencies in improving management of private lands. Consultive assistance is available to ranchers for solving range problems and for developing improved management plans. Financial assistance is also available through cost-share programs to stimulate private investments in conservation practices on private lands.

A recently initiated interagency program has also made it possible for ranchers with grazing permits on public lands to develop a coordinated plan of management with the public agencies involved. Where coordinated planning is properly utilized, range-livestock problems involving multiple ownerships can be dealt with, and progress in solving multiple resource management problems is usually much greater.

WATER DEVELOPMENT NEEDS

Irrigation

The acreage of irrigated area was determined by means of the PIXSYS Landsat program. It shows the irrigated area as 38,820 acres. As discussed in the problems section there is insufficient annual water yield to provide full season irrigation for this acreage.

The natural runoff pattern is such that most of the water yield occurs in the period March through May. If irrigation is to be used most effectively, water must be stored for late season use. Possible reservoir sites have been identified. The mean yield was estimated to be 66,900 acre-feet. With storage, 85 percent of this would be available for irrigation. Approximately 56,900 acre-feet would be available for irrigation on a mean annual basis.

Approximately 15,100 acres could be irrigated annually with an irrigation efficiency of 33 percent. If the overall efficiency could be improved to 50 percent the potential acreage would be increased to about 22,900 acres.

Municipal and Industrial Water Supply

Lakeview water supply is inadequate to meet future growth needs. Alternative solutions include more wells which does not appear to be a viable alternative since wells along the east side of the valley are known to be low in quantity. The other alternative is stored water which has been a proposal in conjunction with the Thomas-Cottonwood Creek Watershed Project.

Fish and Wildlife

Fish and Wildlife needs include more water sources, and dependable water supplies during water short years. Water developments and water rights for fish and wildlife would help to stabilize populations at a desirable level.

Forest and Range Needs

Forest and range water development needs are more related to the use of the resources than to increase in productivity. Increases in productivity, though recognized as an alternative, are not economically feasible now or in the foreseeable future. Two reasons exist for this; one, the lack of a water source during the water short period; and two, the logistics of moving water from sources and disbursing it over the resource areas.

Recreation

There are three immediate needs which would greatly benefit recreational activity in the Basin. These are more water, control of aquatic plants and mosquitos along shorelines, and reduction of suspended sediment loads in existing reservoirs.

EXISTING WATER AND RELATED LAND RESOURCE PROGRAMS AND PROJECTS

EXISTING WATER AND RELATED LAND RESOURCES PROGRAMS AND PROJECTS

INTRODUCTION

Federal, state, and local programs and projects are contributing technically and financially to solving the problems and needs to preserve and develop these resources. These programs and projects are described in two groups: those on privately-owned lands with the individual farmer responsible for the management, and those on publicly-owned lands with public agencies responsible for the management.

FARMER-ORIENTED PROGRAMS AND PROJECTS

Resource programs and projects include those accomplished by individual effort, group action, or organizational functions with assistance from agencies in all strata of the government--federal, state, and local. In these programs and projects, the farmers are imbued with varying degrees of administrative responsibility from primary to secondary, and the farmers receive either no financial help, cost-sharing assistance, or total financing through governmental agencies. Programs and projects are described in the following paragraphs, along with the agency which provides technical or administrative responsibility.

Soil and Water Conservation Districts

All of the Goose Lake Drainage Basin is in the bounds of Soil and Water Conservation Districts. These districts are the Klamath Soil and Water Conservation District in Klamath County and the Lakeview Soil and Water Conservation District in Lake County. Technical assistance to these self-administered districts which are legal subdivisions of the State is furnished by the Soil Conservation Service of the U.S. Department of Agriculture as authorized by the Soil Conservation Act (Public Law 46, 74 Congress, 1935).

Assistance to landowners through the Soil and Water Conservation Districts includes:

1. Soil surveys to provide an inventory of soil resources. This basic information shows the capability of land and serves as a guide in planning needed conservation practices.

2. Conservation farm and ranch plans for individual landowners. These plans delineate the particular needs of the farm or ranch and outlines an action program for the conservation of the soil and water resources which is tailored to the operations and resources of the individual landowner.

3. Technical assistance to plan and apply conservation practices in the following fields: agronomy, biology, engineering, geology,

hydrology, plant materials, range, soils, water forecasting, and woodland. Practices involved are: conservation cropping systems; crop-residue management; pasture and hayland improvement and management; range improvement and management; woodland improvement and management; pond construction; waterway development, farm drainage, including tile and open ditch; land grading and smoothing; irrigation system design; irrigation water management; chiseling and subsoiling; toxic salt reduction; brush control; grazing-land mechanical treatment; range and pasture seeding; spring development; dikes or levees; wildlife-habitat management; and other conservation practices.

4. Technical assistance to groups of landowners to plan and apply drainage and irrigation measures in problem areas involving more than one ownership.

The districts work with individuals, groups. and public agencies on the following: land use planning; weed control; water conservation, development, and management; mosquito and vector control; water, air, and land pollution; recreation and beautification planning and development.

Agricultural Stabilization and Conservation Service

The Agricultural Stabilization and Conservation Service is administered by a three-man county committee in each county in the Basin. The programs consist of grain price support loans; potato surplus diversion; wool incentive payments; loans for construction of grain storage; wheat, feed-grain, and cropland adjustment; assistance in natural disaster and emergencies; and conservation cost-sharing.

This agency at the state and local level administers the Agricultural Conservation Program which provides cost-sharing to partly defray the cost of carrying out essential conservation practices. Practices for which cost-sharing are available in this Basin are as follows: establishment of permanent protective cover for soil protection and improvement of structure, permeability, and water-holding capacity of the soils; establishment of trees and timber-stand improvement on farmland; improvement of meadows; reseeding of rangeland; deferred-grazing on range-land; fencing of grazing land for protection of vegetative cover; control of competitive shrubs on rangeland; provision of livestock water by means of wells, springs, seeps, dams, pits, ponds, and pipelines; establishment of sod waterways; construction of diversion terraces, ditches, or dikes; construction of erosion control structures, streambank and shore protection; open and closed drains; shaping and land leveling; reorganization of irrigation systems for conservation of water or erosion control; construction of spreader ditches and stock trails; establishment of vegetative cover to provide wildlife food plots and habitat; development or restoration of shallow water areas for wildlife; and construction of ponds or dams for wildlife.

Cooperative Extension Service

The Cooperative Extension Service is supported by the U.S. Department of Agriculture, and by Oregon State University with the cooperation and support of the county governments. It is an off-campus educational function, employing agents qualified in agriculture, home economics, family life, and youth education through 4-H and other organizations. The Extension Service functions as an informal educational system designed to make information and services of Oregon State University, U.S. Department of Agriculture, Experiment Station, and other sources available to the people of the Basin.

The Extension Service makes informational and educational materials on improved crop varieties, livestock, land management use and practices, soil testing, and other similar problems relating to all groups or individuals who are interested. County Extension Agents in Goose Lake Drainage Basin are actively assisting in the identification and solution of water and related land resource problems and needs.

Farmers Home Administration

The Farmers Home Administration negotiates loans, and provides technical assistance to owners or operators of farms and ranches, rural residents, community groups, public bodies, and nonprofit organizations. Loans are made only when credit from other sources is not available at reasonable rates and terms.

The purposes of individual loans are: to buy farms or land to enlarge farms; to construct, repair or purchase buildings; to improve land, develop water, forestry, fish-farming resources; to establish recreational enterprises; to develop, conserve, and make better use of soil and water resources; to purchase livestock and equipment; to build or finance the purchase of homes; and to assist farmers who suffer from a natural disaster such as hail, flood, or drought.

The purposes of group loans (including loans to public bodies and nonprofit organizations) are: to develop domestic water-supply systems and waste disposal systems; to develop irrigation, drainage, and other soil and water conservation facilities; to develop community recreational facilities; to develop grazing associations including the purchase and improvement of land; to develop forestry associations; to construct migrant labor camp facilities; and to construct rural rental housing facilities.

Soil Conservation Service

The Soil Conservation Service is the technical agency of the U.S. Department of Agriculture for developing and carrying out a national soil and water conservation program. The programs of the Service generally are administered through soil and water conservation districts as authorized by the Soil Conservation Act (Public Law 46, 74 Congress, 1935). Soil conservationists, soil scientists, range conservationists, engineers, agricultural economists, geologists, and plant technology specialists work together to accomplish the programs and practices previously listed under the soil and water conservation districts section.

The Watershed Protection and Flood Prevention Act (Public Law 566, as amended) authorizes the Secretary of Agriculture to give technical and financial help in planning and carrying out watershed projects. The Soil Conservation Service has been assigned the responsibility to plan and administer a program of water development for agriculture, municipal, recreational, and fish and wildlife uses in addition to flood prevention in watershed areas which are no larger than 250,000 acres. One project is presently authorized for planning in the Goose Lake Drainage Basin.

The Soil Conservation Service administers the Cooperative Snow Survey for water-supply forecasting for the Goose Lake Drainage Basin. Surveys have been conducted in the Basin since 1926, and, at present, 8 snow courses are established and the snow is measured at specific intervals during the snow season. From the snow service data, monthly and annual forecasts are made of the water available for all uses. These reports are distributed to water users and resource agencies. The snow survey is conducted in cooperation with the Oregon Agricultural Experiment Station and State Engineer of Oregon. Many private, state, and Federal agencies have cooperated with the responsible agencies in the measurement of snow courses.

The Service has been assigned leadership within the Department of Agriculture for the Federal part of the National Cooperative Soil Survey which provides essential soils information for use by landowners and operators and community planning officials and engineers. It represents the Department of Agriculture in river-basin planning, survey, and investigations; has leadership for the program of the Department for income-producing recreation on rural private lands; assists local sponsors of resource conservation and development projects; and provides technical assistance in the cost-sharing, credit, and rural areas development programs of the Department.

AGENCY-ORIENTED PROGRAMS

Cooperative State-Federal Programs

The Cooperative Forest Management Act of 1950 provides forest management service to all privately owned forests with emphasis on the small woodland owner. Through the program the woodland owner can obtain management advice and assistance on problems peculiar to his own woodland. Technically trained foresters are provided by the state for this service. The Federal Government enters the program by providing monetary assistance as an incentive to the state to set up a farm-forestry program to assist in developing new techniques, training farm foresters, and making appropriate inspections and audits.

The woodland owner can also receive financial assistance for forestry practices including the Forest Incentives Program, and Agricultural Conservation Program. These cost-sharing programs provide funds for such activities as 1) planting trees for forestry purposes, 2) thinning, 3) release of desirable tree seedlings from competing vegetation, 4) site preparation for natural seeding, 6) fencing the improved woodland area, and 6) erosion control on logging roads.

Other cooperative efforts are also incentives to provide better forest management and protection to state and private forest lands. The Clarke-McNary Act provided for establishment of nurseries in the states while the Forest Incentives Program and the Agricultural Conservation Program provides technical assistance and cost-sharing to carry out programs of land conservation. These programs were consolidated and broadened by the Cooperative Forestry Assistance Act of 1978 (PL 95-313).

Fire has been a devastating enemy of the forests of Oregon. Two large fires have wrought much destruction in the Basin in recent years. The Cooperative Fire Program provides an effective means of Federal-State fire prevention and suppression activities to reduce the impacts of such fires on natural resosurces.

Another important Federal-State cooperative effort is the Forest Insect and Disease Management (FIDM) Program. Insect and disease activities throughout the state are monitored and control programs initiated when necessary through this Program.

Pacific Northwest Forest and Range Experiment Station

Studies conducted by the Experiment Station have contributed significantly to management of National Forests as well as those lands in other ownership. The Station has no specific programs in the Basin at this time; however, the results of research in adjacent areas of similar ecology are applicable to the lands

of the Basin. These studies include improved methods of resource utilization, increases of yields including water, and rehabilitation of areas damaged through previous use. Ten project laboratories are set up as part of the Experiment Station to handle specific areas including the Range and Wildlife Habitat Laboratory at La Grande, Oregon; the Forest Hydrology Laboratory at Wenatchee, Washington; and the Silviculture Laboratory at Bend, Oregon.

The studies, which are conducted by the various laboratories, result from specific problems experienced in the field by resource managers. The studies are not necessarily "laboratory" oriented because the work is actually done in the field under resource management situations. The results are, therefore, generally already field tried and proven by the time the laboratory has completed a study.

Bureau of Land Management

The Bureau of Land Management (BLM) is responsible for administration of the public domain lands in the Basin, totalling 2,520 acres. These lands have been managed under the multiple-use concept of the greatest good for the greatest number in the long run, even though the BLM lacked a general mandate to do so until 1976. The Federal Land Policy and Management Act of 1976 corrected this omission and strengthened the position of the Bureau in the performance of its duties to manage these lands.

The new Act calls for preparation and maintenance of an inventory of public lands and their resource and other values. Information from the inventory is to be made available to state and local governments for their use in planning and regulating uses of non-Federal lands in the vicinity of the public lands. The Act requires that plans for public lands be developed, revised, and maintained regardless of whether the lands have been previously withdrawn or designated, and public involvement in the process is required.

There are many guidelines and procedural requirements for planning in the Act. Some of them are: Use of multiple-use principles, use of an interdisciplinary approach, consideration of present and potential uses, giving priority to areas of critical environmental concern, and provision for compliance with applicable pollution control laws, including state standards and implementaiton plans.

Extensive consultation and coordination with state and local entities is required, as well as consistency of Federal plans with state and local plans to the maximum extent that the Secretary finds consistent with Federal law and the purposes of this Act.

The BLM has a system and program for land-use planning which was initiated in 1969, resulting in first generation plans. The Bureau is in the middle of this planning effort and when completed a second generation plan will exist which incorporates the requirements of the 1976 Federal Land Policy and Management Act.

The BLM has three basic components in the course of land-use planning. These are resource inventory interpretation component, which is called a Unit Resource Analysis, a social, economic, and institutional value interpretation component called Planning Area Analysis, and a land-use plan formulation component--The Management Framework Plan. The details for these components are contained in BLM manuals and directives.

National Forest Programs

The Lakeview District of the Fremont National Forest administers 180,820 acres or 39 percent of the Goose Lake Basin. These lands, primarily timber-producing sites, account for 79 percent of the timberlands in the study area.

The National Forest portion of the Basin has been managed under a form of multiple-use since 1906. The Organic Act of 1897 provided the basic legislative direction for administration of these public lands. Each legislation through the years has given strength to existing Forest Service management objectives and added new perspectives to old concepts.

There are more demands upon finite resource, the National Forest and the public is more aware of the opportunities available and has a stronger desire to have a say in the decision processes. The Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974 and the National Forest Management Act (NFMA) of 1976 have acknowledged these situations.

The Forest and Rangeland Renewable Resources Planning Act (RPA) provided that:

> "SEC. 2. RENEWABLE RESOURCE ASSESSMENT.--(a) in recognition of the vital importance of America's renewable resources of the forest, range, and other associated lands to the Nation's social and economic well-being, and of the necessity for a long-term perspective in planning and undertaking related national renewable resource programs administered by the Forest Service, the Secretary of Agriculture shall prepare a Renewable Resource Assessment (hereinafter called the "Assessment"). The Assessment shall be prepared not later than December 31, 1975, and shall be updated during 1979 and each tenth year thereafter, and shall include but not be limited to--

(1) an analysis of uses, demand, and supply of renewable resources;

(2) an inventory of renewable resources;

(3) a description of Forest Service programs and responsibilities.

(4) a discussion of important policy considerations, laws, and regulations.

The National Forest Management Act (NFMA) amends the RPA to further clarify the need for coordinated planning efforts.

The Forest Service is responsible for administering the National Forests and Grasslands. The citizens of this county are concerned about the wise use and management of these lands. They also want to have a role in decision making processes relative to these lands. Public concerns give rise to alternative choices in how land is used today and tomorrow.

In view of today's concerns, a new National system of land-use planning has been developed and is being implemented.

It starts with identifying National needs and objectives and culminates in plans for managing a specific area of land.

The process has four interrelated parts: The National Assessment, the Regional Plan, the National Forest Land-Use Plan, and the Program Budget. The separate parts are defined in the Resources Planning act and the National Forest Management Act.

One purpose of the planning process is to seek agreement between the public and those responsible for management of the land on resource development and use. The Fremont National Forest land plan will reflect the optimum attainable benefits to be derived from the land and the costs of obtaining those benefits. The forest plan therefore will reflect the needs which the local public expects will be met, but within the constraints required to meet national goals and objectives.

The planning process is intended to integrate all functional resource planning and thereby improve upon previous planning methods of developing multiple-use, land use, unit or other types of plans. The planning process should result in both allocating land to specific uses and assuring that resource management goals are achieved.

Planning will guide all natural resource management activities, and will determine the forest management system; harvesting level and procedures under the principles of multiple use and sustained yield and the availability and suitability of lands for resource management.

WATER AND RELATED LAND RESOURCE DEVELOPMENT POTENTIAL

WATER AND RELATED LAND RESOURCE DEVELOPMENT POTENTIAL

INTRODUCTION

Opportunities exist in many areas of the Basin for development of water and related land resources. To develop this potential, the problems must be solved and the needs must be supplied. These solutions sometimes involve a large group of people and require an organization to sponsor a project. Individuals or small groups of three or four landowners often can work out the solutions to their problems and needs.

PROJECT POTENTIAL UNDER PUBLIC LAW 566

Description of P.L. 566

The Watershed Protection and Flood Prevention Act, Public Law 566, as amended authorizes the Secretary of Agriculture to cooperate with local organizations in planning and carrying out works of improvement for flood prevention and/or for the conservation, development, utilization, and disposal of water in watershed or sub-watershed areas smaller than 250,000 acres. The Act provides for technical, financial, and credit assistance by the U.S. Department of Agriculture to landowners, operators, and other people living in small watersheds. Project-type action under the Act is intended to supplement other soil and water conservation programs and other programs for the development and flood protection of major river valleys.

Watershed Survey

The USDA Oregon River Basin Survey Staff surveyed the potential for P.L. 566 and, as one of the objectives of the study, in the Goose Lake Drainage Basin. The basin is basically two watershed areas, Drews Creek and Thomas-Cottonwood Creeks. The Thomas-Cottonwood Creek watershed appears to have the best potential for a PL 566 project in this basin.

PROGRAMS AND PROJECTS ON PUBLIC LANDS

National Forest Projects and Programs

The primary concern of resource development plans has been to provide "multiple uses" of the forest resources on a sustained-yield basis for "the greatest good of the greatest number." Ecology has been a part of this management; however, its role in management decisions has never been clearly defined or understood by all resource people. The impact of each decision to use the resources of the land, air, and water was not always viewed as accumulative by resource managers.

Forest Service ecologists are providing a clearer picture of where managers are today and where they should be in managing our resources.

Instead of comparative judgement of the condition of the resource base, the resource is judged upon its ecological capability to produce and be used. National Forest lands in the Goose Lake Drainage Basin are in relatively good condition to respond to proper management. Timber and rangelands are in fair to good ecological condition.

Programs now underway will eventually provide the necessary tools to consolidate the basic data available on each of the resources. One of these programs is known as the TRI-SYSTEM or Total Resource Information for Land Management. Modern computorization has made it possible to store information necessary to determine the complex interaction of soil, water, vegetation and animals. The impact of any interference with the ecological processes may be predicted from the data available with reasonable accuracy. Once the system is activated, resource managers can explore alternative decisions to determine which will not have a detrimental effect on the ecology of an area and finally which decision will have the least impact upon other resources.

The key to success of this program is good basic data. The resource manager can no longer serve as a source of all data needed. Experts in the specialized field are gathering basic data for disciplines such as ecology, soils, hydrology, and geology. The resource manager must be able to consolidate available data if he is to make the best decision. Through the TRI-SYSTEM, resource managers can better understand the results of past decisions and predict the results of current decisions, thus avoiding many pitfalls.

Cooperative State-Federal Forestry Program

There is opportunity for additional cooperative forestry programs within the Basin. The bulk of the timber lands within the Basin are in Federal ownership or large private holdings. The possibilities for cooperation are in the areas of insect and disease control, fire control, timber stand improvement, regeneration, and erosion control.

APPENDIX

Table 29.--Vegetative Cover and Land Use, Goose Lake Drainage Basin, Oregon, 1976

Symbol	Acres	Description
		FORESTED
J	5,389	Juniper dominated rangeland with sagebrush, rabbitbrush, bitterbrush understory; and sparse grass and forbes ground cover.
G	22,647	Associated species stands where Ponderosa pine is dominant in canopy with white fir nearly codominant.
Q	2,879	Associated species stands where lodgepole pine dominates the canopy.
&	69,174	Associated species stands where Ponderosa pine dominates the canopy.
#	18,787	Associated species stands where white fir dominates the canopy.
@	1,569	Lodgepole pine stands.
$	39,150	Open Ponderosa pine stands.
*	5,100	Dense Ponderosa pine reproduction.
R	41,155	Burns and clearcuts with low brush (o-3') and open Ponderosa pine stands.
		ROCK
~	12,762	Rock.
		WATER
W	8,023	Water
		BRUSH
:	51,034	Brush-grass range. Bitterbrush is a codominant brush with tall sagebrush then rabbitbrush. Grasses are natural species. Juniper may be predominant on east and north falling slopes replacing the bitterbrush as the dominant species.
a	16,922	Brush-grass range. Low sagebrush dominates the vegetation. Much bare soil exists (20-40%). Other brush includes rabbitbrush.

Symbol	Acres	Description
;	14,625	Brush dominated range within the forested area. Feid dominates the grasses while Artr dominates the brush.
T	2,561	Burns and clearcuts occupied by dense brush 4-10 feet tall.
		GRASS
K	9,429	Grass-shrub range (includes old heavily grazed seedings which have been re-invated by brush). Grass dominates the vegetation. Much bare soil exists (20-40%). Sage is of the low sage type.
C	1,686	Improved dry range with good stand of grass and very little bare soil (less than 10%).
J	3,393	Wet meadow with sedges, rushes, and bluegrasses and a sagebrush overstory.
)	8,632	Wet meadows with native species of grasses, sedges, rushes.
∞	2,350	Alkaline soils with high water table, may even have near surface water, and good stands of grass.
↑	2,223	Alkaline soils with poor stands of grass or cereal grains. The alkaline soil dominates the signature. Some sites have been plowed and seeded to cereal grains. These stands were sparse and the natural grasses tend to come back immediately.
		CULTIVATED CROPS
o	6,113	Alfalfa hay and clover dominated fields.
(	11,050	Irrigated pastures with good stands of grass. Pastures have been moderately grazed. (Includes seeded wet meadows.)
÷	602	Irrigated pastures with excellent stands of grass which are heavily used (includes the golf course) to give a mown appearance.
+	16,115	Irrigated cereal grains.
⊓	11,799	Dryland cereal grains.
△	15,591	Wheatgrass - seeded mostly for pasture
→	4,939	Irrigated grass hay (improved seeded species).

Symbol	Acres	Description
		BARE SOIL
•	2,311	Bare soil, not alkaline. These are recently plowed or recent fallow fields.
9	1,472	Bare alkaline soil, may be recently plowed, fallowed, or just not productive.
—	4,458	Bare soil (includes overgrazed meadows).
		RIPARIAN VEGETATION
←	3,211	Willows and related tall brush such as cottonwoods and good ground cover of sedges and Poa (bluegrass).
↓	5,866	Cattails, rushes, marsh grasses, sedges.
		UNCLASSIFIED
c/c	3,771	Unclassified
		OMITTED
	36,482	Area not included in classification.
	464,270	Total

Vegetative Cover and Land Use Maps

R16E.

R17E.

R18E.

T 37 S.

T 38 S

T 39 S

T 38½ S

SHEET INDEX

SHEET NW¼

VEGETATIVE COVER AND LAND USE

GOOSE LAKE DRAINAGE BASIN

LAKE COUNTY

OREGON

OCTOBER 1977

1 0 1 MILES

SCALE 1:48,000

Base map prepared by U.S. BUREAU OF RECLAMATION, Computer Center, compilation.

UNITED STATES DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

USDA SCS PORTLAND OR 1979

SHEET NE ¼

VEGETATIVE COVER AND LAND USE

GOOSE LAKE DRAINAGE BASIN

LAKE COUNTY

OREGON

OCTOBER 1977

MILES

SHEET INDEX

R 19E

T 36 S

R 18E

R 20E

R 7E

T 37 S

R 21E

T 38 S

N

USDA SCS PORTLAND OR 1979

R.18E. R.19E. R.20E.

T. 38 S.

T. 39 S.

T. 40 S.

T. 41 S.

SHEET INDEX

VEGETATIVE COVER AND LAND USE

Symbol	Description
-	Alfalfa hay and clover dominated fields.
-	Irrigated pastures with good stands of grass. Pastures have been moderately grazed. (Includes seeded wet meadows.)
+	Irrigated pastures with excellent stands of grass which are heavily used (includes the golf course) to give a mown appearance.
-	Wet meadows with native species of grasses, sedges, rushes.
~	Alkaline soils with high water table, may even have near surface water, and good stands of grass.
+	Alkaline soils with poor stands of grass or cereal grains. The alkaline soil dominates the signature. Some sites have been irrigated and planted to cereal grains. These stands were sparse and the natural grasses tend to come back immediately.
-	Bare soil, not alkaline. These are recently plowed or recent fallow fields.
-	Bare alkaline soil, may be recently plowed, fallowed, or just not productive.
-	Irrigated cereal grains.
+	Dryland cereal grains.
-	Wheatgrass - seeded mostly for pasture.
+	Willows and related tall brush such as cottonwoods and good ground cover of sedges and Poa (bluegrass).
+	Cattails, rushes, marsh grasses, sedges.
+	Irrigated grass hay (improved seeded species).
+	Grass-shrub range (includes old heavily grazed seedings which have been re-invaded by brush). Grass dominates the vegetation. Much bare soil exists (20-40%). Sage is of the low sage type.
o	Brush-grass range. Low sagebrush dominates the vegetation. Much bare soil exists (20-40%). Other brush includes rabbitbrush.
c	Improved dry range with good stand of grass and very little bare soil (less than 10%).
-	Brush-grass range. Bitterbrush is a codominant brush with tall sagebrush then rabbitbrush. Grasses are natural species. Juniper may be prodominant on east and north falling slopes replacing the bitterbrush as the dominant species.
j	Juniper dominated rangeland with sagebrush, rabbitbrush, bitterbrush understory, and some grass and forbes ground cover.
q	Associated species stands where Ponderosa pine is dominant in canopy with white fir nearly codominant.
q	Associated species stands where lodgepole pine dominates the canopy.
b	Associated species stands where Ponderosa pine dominates the canopy.
a	Associated species stands where white fir dominates the canopy.
e	Lodgepole pine stands.
-	Open Ponderosa pine stands.
d	Wet meadow with sedges, rushes, and bluegrasses and a sagebrush overstory.
s	Dense Ponderosa pine reproduction.
m	Burns and clearcuts with low brush (0-3') and open Ponderosa pine stands.
r	Burns and clearcuts occupied by dense brush 4-10 feet tall).
-	Rock.
-	Bare soil (includes overgrazed meadows).
-	Brush dominated range within the forested area. Feid dominates the grasses while Artr dominates the brush.
w	Water.
u	Unclassified.

Source:
Base map prepared by SCS, WTSC Carto Staff from ERSAL - OSU Computer Center, compilation.
UNITED STATES DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

SHEET SE¼

VEGETATIVE COVER AND LAND USE

GOOSE LAKE DRAINAGE BASIN

LAKE COUNTY

OREGON

OCTOBER 1977

0 1 MILES

SCALE 1:48,000

USDA-SCS-PORTLAND, OR. 1979

SHEET INDEX

R 16 E
R 17 E
R 18 E
R 19 E
R 15 E
T 39 S
T 40 S
T 41 S

SHEET SW¼

VEGETATIVE COVER AND LAND USE

GOOSE LAKE DRAINAGE BASIN

LAKE COUNTY

OREGON

OCTOBER 1977

SCALE 1:48,000

NOTE: REFER TO THE SE 1/4 SHEET FOR LEGEND

Sources:
Base maps prepared by SCS, W.T.S.C. Cartographic Staff from EROS/LANDSAT Computer Center, compilation.
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